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FOREWORD

Dear esteemed colleagues,

I wish all is truly well with you. To be honest, we'd planned to publish this journal since 2024 March. However, our faculty members were engaged with academic affairs starting from January, 2024 so that 3 months passed in a blink of an eye. Finally, we can publish Journal of Dental Science-UDMY Volume 4 in June, 2024. It is a great auspicious and fruitful outcome which will remain as a historical milestone. Nowadays, our dentistry world has been challenged by emerging technical innovation including AI (Artificial Intelligence). As we all are dealing with patients in daily dental practice, dissemination of updated knowledge on various clinical disciplines to our professional colleagues is our primary concern and it is a paramount importance for academicians. The most beautiful thing in the world is the thing what you have done for the others. Hopefully, this journal will be a catalyst for all dental professional colleagues. I strongly believed that a variety of original articles in this issue will fulfil their requirement. The advanced oral surgical techniques and applied clinical research works done in Dental Universities were published in this issue. As "knowledge is a powerful tool", we would be too much honored if our colleagues could grab some meaningful powerful tools from the clinical and research findings included in this journal. According to saying "Getting together is beginning; keeping together is process and working together is success", we materialized our dream successfully with our collective strength and we reached our destination at last. I would like to express my sincere heartfelt gratitude to all my colleagues who devoted their precious time and put their sustainable effort to develop this material. We look forward to creating more and more brighter academic atmosphere in near future.

Professor Shwe Toe
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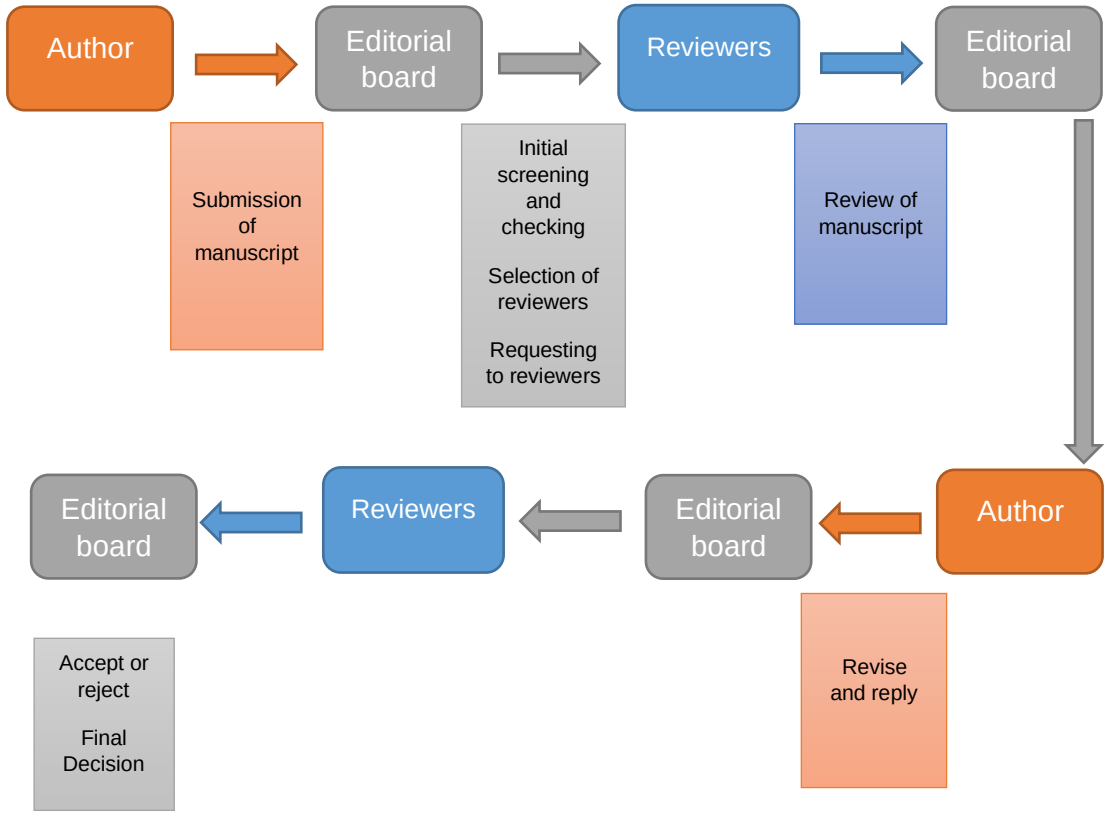

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Detection of Promoter Methylation of Ras Association Domain Family 1 Isoform A Gene in Oral Squamous Cell Carcinoma

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Abstract **- Oral squamous cell carcinoma (OSCC) is the most frequent cancer in oral cavity and one of the major global health problems. Ras Association Domain Family 1 Isoform A (RASSF1A) gene is a tumor suppressor gene and its inactivation by promoter methylation is believed to play an important role in carcinogenesis of OSCC. The aim of the present study was to detect the methylation status of RASSF1A gene in oral squamous cell carcinoma cases. A total fifty-two formalin fixed paraffin-embedded tissues of histopathologically proven OSCC cases were subjected to find out the promoter methylation of RASSF1A by using methylation specific PCR (MSP) method. According to the results of this study, RASSF1A methylation was observed in 35 cases (67.3%) of OSCC. There was no statistically significant association between RASSF1A methylation and clinical parameters (site and size) of OSCC patients (*p* = 0.374, *p* = 1.000 respectively). Regarding the histological parameters of OSCC, a statistically significant association between histological grading and methylation status of RASSF1A was not found (*p* = 0.092). There was a statistically significant association between lymph node involvement and methylation of RASSF1A (*p* = 0.031). The results indicated an important role of RASSF1A methylation in nodal metastasis of OSCC. The findings from this study give an idea for clinical usage of potential novel drugs which inhibits for methylation of DNA and these emerging drugs combined with radiotherapy and chemotherapy could enhance the effectiveness of routine treatment.**

Keywords: oral squamous cell carcinoma, promoter methylation, RASSF1A gene

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Introduction

Oral squamous cell carcinoma (OSCC) is the most frequent cancer and accounts for approximately 90% of all malignancies of the oral cavity (Feller & Lemmar, 2012). The global burden of oral cavity squamous cell carcinoma (OCSCC) is 3.90/100,000, whereas the mortality rate of oral cavity tumors is around 1.94/100,000 people (Liu *et al*., 2021). The study of Global Cancer Observatory in Myanmar, the incidence of oral cance was 3.4% of all new cancer cases and placed at eighth position in 2018 (World Health Organization, 2018). In the Southeast Asia countries, the incidence was the highest in Myanmar and Brunei for males and females

respectively which can be attributed to the same cultural practices and habits (Cheong *et al*., 2017). Recent epidemiology data published by the National Cancer Institute (NCI), showed that the overall survival rate for OCSCC in a 5-year period is 63% with a range between 83% in early stages and 38% in advanced stages (Al Feghali *et al.*, 2019). Therefore, there have been continuous studies and reports on molecular complexity of OSCC which decides the progression of disease.

The pathogenesis of OSCC is a multistep process modulated by accumulation of multiple genetic and epigenetic alterations which modify normal cellular functions by increased proliferation, loss of cell cohesion and ability to invade and metastasize (Campo-Trapero *et al.*, 2008). The heritable modification and reversible changes in gene expression without changes in the sequence of DNA designated as epigenetic modification has been recognized as another mechanism for development of OSCC (Lingen *et al*., 2011). DNA methylation is a major epigenetic modification that is strongly involved in the physiological control of genome expression. Methylation occurs within the cytosine-phosphate-guanine (CpG) island in the promoter region which is normally unmethylated (Irimie *et al*., 2018). Aberrant DNA methylation may lead to silencing of important genes, such as tumor suppressor genes, affecting their related transcriptional pathways and ultimately leading to development of cancer including OSCC (Diez-Perez *et al*., 2011; Jithesh *et al*., 2013; Gaździcka *et al*., 2020).

Ras Association Domain Family 1 Isoform A (RASSF1A) is a tumor suppressor gene which modulates the cell cycle and apoptosis as well as plays an important role in controlling cell motility, invasion and cellular adhesion and its inactivation is associated with development of many cancers (Donninger *et al*., 2007). Promoter methylation has been reported to be the major mechanism for silencing RASSF1A in OSCC (Dong *et al*., 2003). RASSF1A gene promoter methylation was present in 93% of betel-associated OSCC in Vietnam (Tran *et al*., 2005). Their study suggested that epigenetic silencing of RASSF1A gene by promoter methylation plays a critical role in betel-associated oral carcinogenesis. Other studies also revealed that poorly differentiated OSCCs were more commonly methylated for RASSF1A than moderately and well differentiated neoplasm (Hogg *et al*., 2002; Gaber *et al*., 2018). A study done by Huang and colleagues (2009) also found that promoter methylation of RASSF1A gene was significantly higher in tongue cancer and positively correlated with tumor size.

In contrast to genetic changes, epigenetic modifications are potentially reversible and are a good therapeutic target. Many studies demonstrated that after treatment with demethylation agent in methylated OSCC cell line, no methylation of the promote region of RASSF1A gene was found (Dong *et al*., 2003; Koutsimpelas *et al*., 2012). DNA methyltransferase inhibitors such as 5-azacitidine and decitabine have been already used in the treatment of several malignancies and these epigenetic-

based drugs have been shown as anticancer enhancing agents in combination with chemotherapy and radiotherapy (Mascolo *et al*., 2012).

Despite recent advances in the molecular pathology of oral cancer, there remain numerous gaps in knowledge of the molecular markers involved in oral carcinogenesis. In addition, the study of promoter methylation status of RASSF1A in OSCC has not yet been conducted in Myanmar. This study aims to detect promoter methylation status of RASSF1A in patients with oral squamous cell carcinoma and to find out the association between promoter methylation status of RASSF1A and clinicopathological data of OSCC patients. Therefore, the findings from this study might provide useful information regarding prognosis and contribute to the search of potential targeted chemotherapeutic strategies in oral squamous cell carcinoma.

Materials and Methods

A cross-sectional descriptive study was carried out from January 2021 to October 2022. A total of 52 oral squamous cell carcinoma patients attending University of Dental Medicine, Yangon were collected by using consecutive sampling method. Patients with clinically diagnosed oral cancer were selected and explained about the research purpose, procedures and benefits of the study. After obtaining informed consent, thorough history taking, clinical examination and tumor staging were performed and data were recorded in the proforma. Incisional and/or excisional biopsies were performed by Oral and Maxillofacial surgeon at Department of Oral and Maxillofacial Surgery, University of Dental Medicine, Yangon and the specimens were preserved in buffered formalin and processing and embedding were performed at Department of Oral Medicine, University of Dental Medicine, Yangon. All Haematoxylin and Eosin (H & E) stained tissue sections of histopathogically proven oral squamous cell carcinoma were examined under ordinary light microscope at Department of Oral Medicine, UDM (YGN). Histological grading was done according to Broders' classification under supervision of supervisor and recorded in proforma (Broder, 1920 cited in Pindborg *et al*., 1997).

Then, all histologically confirmed oral squamous cell carcinoma cases were sent to Pathology Research Division, Department of Medical Research, Yangon, for methylation specific Polymerase Chain Reaction (PCR). DNA extraction and bisulfite modification were done by using EpiTect®Fast DNA bisulfite kit, Qiagen. The concentration/yield (ng/µl) and purity of extracted/ template DNA were measured with Nanodrop spectrophotometer (Thermo Fisher Scientific, USA). The bisulfite modified DNA was used as templates for detection of promoter region methylation of RASSF1A gene by using ALLin^{TM} HS Red Taq Mastermix, 2X (Figure 1). Two pairs of primers (one pair for methylated gene and the other pair for unmethylated gene) were used to amplify bisulfite modified DNA of RASSF1A gene (Table 1). Amplification was carried out according to manufacturer's

instructions with the use of thermocycler, and the amplicons of unmethylated DNA and methylated DNA were 180 bp and 160 bp long respectively. After amplication, the amplicons were analyzed by using 2% agarose gel electrophoresis followed by ethidium bromide staining and visualization with BioDoc-It imaging system. The amplicons for the methylated and unmethylated DNA were seen as clear bands upon agarose gel electrophoresis which can be compared to the positive control (human gene and methylated endometrial carcinoma) and negative control (aqueous solution) (Figure 2).

This study was approved by Research and Ethical Committee of University of Dental Medicine, Yangon.

Statistical Analysis

Data were analyzed by using statistical package for social science (SPSS) version 22.0. Descriptive and summary statistics were carried out. For the categorical data, frequency and percentage were calculated. For the continuous data, mean and Standard Deviation (SD) was calculated.

Results

Clinicopathological findings

Table (2) summarizes the clinicopathological features of all cases examined in the present study. The average age of the 52 patients with OSCC (male, 31; female, 21) was (54.81 ± 10.28) years. According to the site of the tumors, the most common site was buccal mucosa followed by gingiva and tongue. The average size of the tumor was (3.4 ± 1.64 cm). The most common habit was betel quid chewing which was followed by tobacco smoking and alcohol drinking. Histopathological examination showed 35 cases (67.3%) were well differentiated, 12 cases (23.1%) were moderately differentiated, and 5 cases (9.6%) were poorly differentiated squamous cell carcinoma. The presence of metastatic tumor cells in the regional lymph nodes was found in 40 out of 52 cases (76.9 %).

Methylation specific PCR (MSP) results:

The results showed that RASSF1A methylation was detected in 35 (67.3%) oral squamous cell carcinoma patients and RASSF1A methylation was not detected in the remaining 17 patients (32.7%) (Table 3). There was no statistically significant association between RASSF1A methylated and unmethylated cases in site (p = 0.374) (Table 4), tumor size (p = 1.000) (Table 5) and histological grading (p = 0.092) (Table 6). There was a statistically significant association between lymph node involvement and methylation of RASSF1A with the p value of 0.031 (Table 7).

Table 1. Primer sequences of methylated and unmethylated RASSF1A

Primer	Sequence
RASSF1A Methylated Forward Primer	5′ GTT GGT ATT CGT TGG GCG C 3′
RASSF1A Methylated Reverse Primer	5′ GCA CCA CGT ATA CGT AAC G 3′
RASSF1A Unmethylated Forward Primer	5′ GGT TGT ATT TGG TTG GAG TG 3′
RASSF1A Unmethylated Reverse Primer	5′ CTA CAA ACC TTT ACA CAC AAC A 3′

Figure 1. Equipment and Reagents for DNA Extraction and Methylation Specific PCR

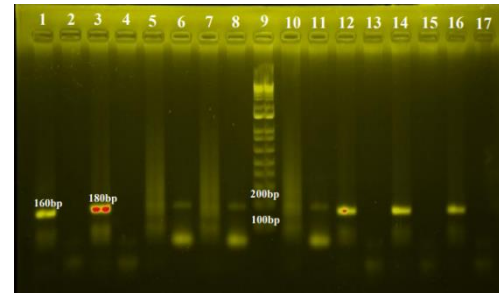

Figure 2. Promoter methylation of RASSF1A in oral squamous cell carcinoma using primers for methylated and unmethylated RASSF1A: methylated and unmethylated RASSF1A bands (160bp and 180bp respectively)

Table 2. Description of clinic-pathological results of oral squamous cell carcinoma patients (n=52)

Clinicopathological Data		No.
Age	Mean ± SD	54.81 ± 10.28
	Range	36-76
Gender	Male	31 (59.6%)
	Female	21 (40.4%)
Site	Buccal mucosa	20 (38.5%)
	Gingiva	19 (36.5%)
	Tongue	18 (34.6%)
	Lips	1 (1.9%)
	Floor of the mouth	10 (19.2%)
	Palate	3 (5.8%)
	Vestibule	3 (5.8%)
Size (cm)	Mean ± SD	3.4 ±1.64
	Range	1.5-10
Histological grading	Well differentiated	35 (67.3%)
	Moderately differentiated	12 (23.1%)
	Poorly differentiated	5 (9.6%)
Lymph node involvement	Present	40 (76.9%)
	Absent	12 (23.1%)

Table 3. Distribution of promoter methylation of RASSF1A in oral squamous cell carcinoma by methylation specific PCR (MSP) (n=52)

RASSF1A	Frequency	Percent
Methylated	35	67.3
Unmethylated	17	32.7
Total	52	100.0

Table 4. Relationship between promoter methylation of RASSF1A and sites of oral squamous cell carcinoma (n=52)

Site	Methylated		Un-methylated		*p*
	n	%	n	%	
Lip	0	0.0	1	100	0.32*
Buccal mucosa	12	60.0	8	40.0	0.37
Gingiva	14	73.7	5	26.3	0.45
Tongue	14	77.8	4	22.2	0.24
Floor of mouth	6	60.0	4	40.0	0.71*
Palate	2	66.7	1	33.3	1.00*
Vestibule	3	100	0	0.0	0.54*

*Fisher's exact test

Table 5. Relationship between promoter methylation of RASSF1A and size of oral squamous cell carcinoma (n=52)

Size	Methylated		Un-methylated		*P**
	n	%	n	%	
< 2 cm	3	75.0	1	25.0	
2 to 4 cm	22	66.7	11	33.3	1.00
> 4 cm	10	66.7	5	33.3	

*Chi-square test

Table 6. Relationship between promoter methylation of RASSF1A and different histological grades of oral squamous cell carcinoma (n=52)

Histological Grading	Methylated		Un-methylated		*p**
	n	%	n	%	
Well differentiated	20	57.1	15	42.9	
Moderately differentiated	10	83.3	2	16.7	0.09
Poorly differentiated	5	100.0	0	0.0	
Total	35	67.3	17	17	

*Fisher's exact test

Table 7. Relationship between promoter methylation of RASSF1A and lymph node involvement of oral squamous cell carcinoma (n=52)

Lymph nodes involvement	Methylated		Unmethylated		*p**
	n	%	n	%	
Present	30	75.0	10	25.0	
Absent	5	41.7	7	58.3	0.03*
Total	35	67.3	17	17	

*****Statistically significant, Chi-square test

Discussion

Oral squamous cell carcinoma (OSCC) is a malignancy that arises from the mucosal epithelium of the oral cavity. The induction and development of OSCC are due to a sum of genetic changes combined with environmental risk factors (especially tobacco and alcohol consumption but also viral infections and chronic inflammations) that in end lead to alterations in the activity of oncogenes and tumor suppressor genes. Recent studies have shown that the promoter methylation, epigenetic alteration, is also one of the crucial factors that are highly associated with OSCC (Irimie *et al*., 2018).

In the present study, the association between clinicopatho -logical data and promoter methylation status of RASSF1A was done in patients with oral squamous cell carcinoma.

In this study, OSCC patients ranged from 36 to 76 years with the mean age of 54.81 years. A similar mean age of 58 year in OSCC patients was reported by Maruya *et al*., (2004) but an older mean age (67.56 years) for OSCC cases was reported by Gaber *et al*., (2018). On the other hand, younger mean age for OSCC patients was reported in US population by Shiboski *et al*., (2005). These differences might be due to the influence of oral habits and geographical variations. In the present study, males were affected more than females that agrees with most OSCC studies. However, the present male to female ratio (1.48: 1) was difference from previous studies in Southeast Asia countries related to tobacco usage where OSCC cases were at least two times more frequent in males than in females (Cheong *et al*., 2017). This difference may be attributed to the small number of cases in the current study (Table 2).

For the site distribution, the most affected site was the buccal mucosa (38.5%) followed by gingiva (36.5%) and tongue (34.6%). In contrast, the anterior two thirds of the tongue was the most common site in other epidemiological studies in worldwide population (Marocchio *et al*., 2010; Troelfzsch *et al*., 2014). This may be due to the influence of oral habits, nature of occupation and cultural background of the study population. The mean of tumors size of the presented cases was 3.4 cm and about 60% of the ulcer was between 2 cm to 4 cm. The result of this study was similar to the study by Pires *et al*., (2013) in which mean size of tumors was 3.4 cm among 346 cases of OSCC. The most common habit was betel chewing (69.2%) in this study and which was followed by tobacco smoking (44.2%) and alcohol drinking (19.2%). Previous studies showed that the major etiological factors of OSCC are betel quid chewing and tobacco smoking in developing countries (Warnakulasuriya. 2009; Lee *et al*., 2011; Mehdi *et al*., 2018).

In the present study, well differentiated squamous cell carcinoma were 35 cases (67.3%), 12 cases (23.1%) were moderately and 5 cases (9.6%) were poorly differentiated squamous cell carcinoma. Likewise, in India study of Rai and Ahmed (2016) reported that 58.3% were well differentiated, 28.7% were moderately differentiated and 13% were poorly differentiated in total 130 cases of OSCC. In the current study, 40 cases (76.9%) OSCC patients showed

positive lymph node metastasis with variable number of involved nodes. This percentage was nearly similar to that reported by Guo *et al*., (2014) who had found 78% of cervical lymph node involvement. The percentage of positive lymph node metastasis was variable in previous studies due to deference in patient cohorts, environmental factors and methods of detection.

In this study, RASSF1A promoter methylations were detected in 35 cases (67.3%) of OSCC cases and RASSF1A methylation was not detected in the remaining 17 cases (32.7%) (Table 3). In contrast, promoter methylation of RASSF1A in OSCC was reported to be present in 95% of OSCC cases by Tran *et al*., (2005) in betel-associated Vietnamese female population. The promoter methylation of RASSF1A in OSCC was reported to be present in 29% cases by Su *et al*., (2010). However, Noorlag *et al*., (2014) revealed that promoter methylation of RASSF1A was found in only 2% of OSCC cases and their study was restricted to histopathologically confirmed early OSCC. The study done in Egypt by Gaber *et al*., (2018) showed that 30% of RASSF1A methylation in 50 cases of OSCC. These inconsistencies in distribution of RASSF1A methylation among FFPET of OSCC cases might result from the fixative used in the tissue processing, the duration of the fixation, the age of paraffin block, the length of the DNA fragment to be amplified and proportion of tumor and normal tissues in paraffin block. Furthermore, Zhou *et al*., (2013) explained that RASSF1A promoter methylation may be interfered with genetic and environmental factors in different populations.

There were no statistically significant association between RASSF1A methylation and different sites of OSCC cases (Table 4). This finding agrees with the study of 45 OSCC cases reported by González-Pérez *et al*., (2020) in which association of RASSF1A methylation and location of OSCC was not found. On the other hand, the study of 482 OSCC cases in Taiwan population done by Huang *et al*., (2009) revealed that promoter methylation of RASSF1A gene was significantly higher in OSCC of tongue. Moreover, Wen *et al*., (2018) also stated that RASSF1A promoter methylation exerted higher frequency in the tongue tumor than another site tumor in the oral cavity. These inconsistencies may be due to the effect of different sample sizes in the different studies.

There was no statistically significant association between RASSF1A methylation and size of OSCC cases (p = 1.000) (Table 5). This finding is inconsistent with the study reported in Taiwan population by Huang *et al*., (2009) that RASSF1A methylation was significantly found in < 4 cm of tumor size compared to > 4 cm of tumor size in 482 cases of OSCC. It might be due to the larger sample size of study population in their study and alteration in ethic group and environment risk factors. Apart from foregoing study, there has been no study for association of methylation of RASSF1A gene and tumor size of OSCC cases.

Statistically significant associations were not seen between methylation status of RASSF1A and

different histological grades of OSCC (p = 0.092) (Table 6). Likewise, the study of Huang *et al*., (2009) found that there was no statistical correlation of histological grades with the methylation of RASSF1A. Wen *et al*., (2018) also stated that there was no significant correlation between methylation of RASSF1A and histological grades of OSCC in their meta-analysis. Thus, the current result and foregoing results revealed that the histological grades of OSCC did not influence the methylation status of OSCC. On the other hand, the previous studies of Hogg *et al*., (2002) and Gaber *et al*., (2018) reported RASSF1A methylation were significantly higher in poorly differentiated than in well and moderately differentiated OSCC. Therefore, further studies on larger sample size with equal distribution of histological grades of OSCC patients should be conducted to find out the role of RASSF1A methylation in disease progress of OSCC in Myanmar.

According to the findings of this study, a statistically significant association was found between lymph node involvement and RASSF1A methylation of OSCC (p = 0.031) (Table 7). The study reported by Gaber *et al*., (2018) in which RASSF1A promoter methylation in OSCC was found to be statistically significantly correlated to lymph nodes metastasis and number of involved lymph nodes. This finding was similar to the present study in which association of RASSF1A methylation and lymph node involvement was found. Previous studies reported that inactivation of RASSF1A tumor suppressor gene by promoter methylation results in reduced cell-cell adhesion and may be involved in cell motility and migration control (Dallol *et al*., 2005; Donninger *et al*., 2007). Collectively, the current result and previous reports indicated that promoter methylation of RASSF1A may play an important role in nodal metastasis of OSCC.

Conclusion

In the present study, promoter methylation of RASSF1A was found to be 67.3% in this study. This finding pointed out that methylation of RASSF1A is frequently seen in OSCC patients of Myanmar population. The result of this research supports the idea that RASSF1A methylation involves in the development of OSCC and it can be used as a biomarker for early diagnosis of OSCC. There were no statistically significant association between RASSF1A methylation and clinical parameters and histological grades. However, there was a significant association between lymph node involvement and RASSF1A methylation. It indicates that RASSF1A methylation has significant effect on advance stage of OSCC. The results of this study suggest that promoter methylation of RASSF1A may play an important role in metastasis of OSCC. The present study provides a basis for understanding of RASSF1A methylation in fundamentally tumorigenesis process of OSCC. Promoter methylation of other tumor suppressor genes should be warranted in OSCC cases to establish their role in the carcinogenesis and prognostic markers in management of OSCC. These molecular analyses of DNA methylation have the potential to be

adjunct to histopathological assessment in the diagnosis of OSCC. Additionally, combination of demethylating agents with radiotherapy and chemotherapy should also be considered as better treatment options for OSCC.

COI

The authors declare there is no potential conflict of interest.

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In-vitro Comparative Study of Weight Loss and Surface Topographic Changes of Five Commercial Composite Resins after Toothbrushing

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***Abstract* – This study evaluated weight loss and surface topographic changes after simulated tooth brushing of five commercial composite resin restorative materials: one microhybrid (Denfil), one Ormocer (Admira), two nanohybrids (Grandio and Ceram X mono) and one Giomer (Beautifil II). Cylindrical specimens of five composite resin (n=12 for each material) were used. All samples were brushed for 200 min with dentifrice-water slurry in a simulated tooth-brushing machine. This period is clinically equal to two years age of toothbrushing. Before and after simulated toothbrushing, weight loss and surface topographic changes para-meters were determined. The data was statistically analyzed by one way analysis of variance (ANOVA) and Tukey's post hoc test to evaluate the difference among the tested materials and Paired Sample T test to evaluate the surface roughness changes after simulated tooth-brushing. And then, comparing the surface roughness among the tested materials: Denfil, Admira, Grandio, Ceram X mono and Beautiful II. Scanning electron microscope (SEM) observation was done to evaluate the changes in surface topography of all tested composite resin materials before and after simulated toothbrushing. After simulated toothbrushing, statistically significant change in weight loss and surface roughness was detected in all tested materials ($p<0.01$). The results of this study suggested that some important general relationships exist between the compositions, micro-structures and mechanical properties of tested composite resins. The analysis of differences before and after the simulated toothbrushing may provide some further basis for a rational choice of the most appropriate composite resin material from wearing aspect.**

Keywords; toothbrushing, surface roughness, composite resin

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Introduction

When composite resins were first introduced in the late 1950s and early 1960s, they were self-cured and macrofilled with large filler particles in the 25–50 μm range. Composite resin had been originally developed as anterior restorative materials. In early days, physical properties of these materials are inferior to amalgams in several mechanical aspects: wear

resistance, hardness, and shrinkage behaviour. These composite resins, once contoured, had little surface gloss and the patient sensed they were rough when their tongue touched the restoration. However, remarkable advances in their physical properties are leading to significant improvement in their qualities and durability. The introduction in the late 1970s of visible light-cured composite resins with smaller filler particles which were made from synthetic, softer glasses made composites more polishable with improved tooth like translucency. These materials offer the patients with minimally invasive, highly aesthetic direct restorations. Composite resin restorative materials are now standard materials for all types of anterior direct restoration. But in the study of "a clinical evaluation of posterior composite resin restorations: 8-year finding", Collins et. al., (1998) concluded that, at 8 years, composite resin restorations in posterior teeth had failed at a rate two to three times that of amalgam restorations. Hence, their application was still restricted to some extent.

The most traditional composites for restorative purposes are hybrid and microfilled, generally containing filler particles ranging from 0.5 to 4 micrometer, and 0.02 to 0.09 micrometer respectively. In order to improve the properties of composite resin, researchers have focused on the pretreatment of inorganic fillers and resin monomers and the development of curing methods (cited in Xia, 2003). Nowadays, its application is widely spread to restore posterior teeth because of the demand for aesthetic restoration and so-called advantage of allowing the material to be compacted into the cavity and this type of resin material was known as packable composite.

More recently, microhybrid, nanofilled and nanohybrid composites were introduced, in attempt to provide a restorative material that could be used in both anterior and posterior areas, presenting high initial polishing combined with superior polish and gloss retention (Mitra and colleagues, 2003). Nowadays, composite resins are so far the most esthetic restorative material applied in direct restorations.

However, the aesthetic property of these materials is unpredictable due to their discolouration or loss of luster, owing to surface wear.

One of the factors that determine the clinical longevity of a restoration is its surface characteristics. In that, the most important property is the ability to withstand wear, as any loss of substance could result in altering the anatomic shape and affecting the performance of restoration. Ideally, a restoration must provide a smooth and regular surface, but it is not always possible. Despite improvements in mechanical properties and wear resistance in composite materials, wear is still a cause of clinical failure, particularly in high stress areas such as molar restoration (cited in Sarett, 2000). Decreasing wear resistance created the surface roughness of restorations and complicated as plaque accumulation, loss of surface gloss and further attack of caries development. Therefore, adequate wear resistance is the most important requirement for posterior restoration. However, numerous studies have been carried out to investigate the wear of

composite resin restorations and most of them showed that wear is inevitable.

Wear is defined as progressive loss of substance from the surface of a material caused by a mechanical action. Clinically, wear can occur at the occlusal contact area (OCA) (commonly referred to as attrition) and contact free area (CFA) (referred to as abrasion), from grinding of food bolus as well as toothbrushing (abrasive wear) by the action of tooth brush and dentifrice. Abrasion of resin composite, caused by long-term clinical use in the oral environment, includes both occlusal wear and toothbrush abrasion. Clinically wear is seen in the oral cavity by the loss of the original anatomical form of the material. Wear of tooth structure and restorative materials may result from physiological or pathological conditions. Occlusal wear of the composite material is produced by masticatory stress. Toothbrush abrasion, which is another importance phenomenon as regards the wear characteristics of composite are undesirable due to esthetic and biologic disadvantages. During maintaining oral health and restorations, dental tissues and dental materials are subjected to tooth brush/toothpaste abrasion, but an impact of toothbrushing on the appearance of composite resins may occur (cited in Strassler, 1988). This may cause wear on dental tissues and dental materials during the removal of surface deposits especially in the cervical third area of facial surfaces of the teeth. This effect leads to changes in the surface condition of any composite material. In the study of "The effect of tooth brushing on a hybrid composite resin", Goldstein and Lerner (1991) reported that the surface topography of a hybrid composite resin was altered by routine toothbrushing when measuring with profile meter.

Wear properties have been studied by either *in vivo* or *in vitro* methods. Researchers have evaluated the abrasion resistance of filling materials *in vivo* by replica methods in class I, II, and III by measuring the exposed cavity wall height. Although, *in vivo* wear studies would be seen ideal to evaluate the wear behaviour of dental biomaterials, it is very difficult to quantify the wear because of complex individual differences and only a limited number of materials can be examined under the same conditions. Moreover, clinical evaluation is time consuming and always takes one or two years to obtain the results.

In vitro wear of restorative materials has been studied with two-body and three-body abrasion tests. This system has been designed to let the abrasive particles attached to one of the sliding surfaces. In tests of this system, several hard sliders (diamond, pin and disc, and tooth enamel) abrade the specimens. A three-body system has been used by Phillips et. al. (1971), and Akar (1982) have been designed to let the abrasive particles attached to both the sample surface and brush. In this system, toothbrush and slurries of abrasives have been often applied. These systems usually show the conventional composite resin to be superior to amalgam and to the microfilled resin. Amalgam actually wears more slowly *in vivo*. Moreover, the results from many such in vitro wear studies do not show good correlation with the clinical finding.

Moreover, Ehrnford et. al., (1980) proposed a combination wear test of a two-body system and an abrasive slurry. On the other hand, Jone et. al., (1972) and McCabe et. al., (1981) have attempted to assess abrasive wear combining fatigue wear with vibrating.

In most studies, different kinds of brushing machines have been used to measure the wear procedure occurring in the mouth. The behaviour of these different machines on dental restorative materials has been evaluated by various methods,

(a) volume loss, (Aker, 1982)

(b) weight loss, (Kanter et. al.)

(c) thickness loss

(d) surface roughness profilometer

(e) scanning electron micrographs (Ehrnford, 1983) (cited in Lambrechts, 2006).

In the present study, the alteration of surface roughness of different composite resins including microfilled, microhybrid, nanofilled, nanohybrid, and S-PRG filler containing Giomer before and after toothbrushing were investigated. And then the changes in weight of tested materials were observed.

Materials and Methods

The weight loss and wear of five commercial composite resin restorative materials were compared after simulated toothbrushing: one microhybrid: Denfil; one Ormocer: Admira; two nanohybrids: Grandio and Ceram X mono; and one Giomer: Beautifil II. List of these materials used, manufacturers, composition, and batch number are shown in Table 1.

Table 1. Details of tested resin materials

Trade name	Manufacturer	Lot number	Main composition	Average Filler particle size	Filler content wt% / vol%
DenFil	Vericom, Korea	DF 2417922	Microhybrid Bis GMA, TEGDMA	≤1.0 µm	80% wt
Admira	VOCO,GmbH Germany	1002512	Ormocer based microfilled 3-dimensionally linked inorganic -organic copolymer (ORMOCERS) Additive aliphatic aromatic dimethacrylate	0.7 µm	56% vol
Grandio	VOCO,GmbH, Germany	1047274	Nanohybrid Matrix: Bis-GMA, UDMA, TEGDMA, dimethacrylate	0.1-2.5 µm[0] 20-50 nm[0]	71.4% vol 87% wt
Ceram® X mono	Dentsply Asia	13030000 81	Nano-ceramic Methacrylate mod-ified polysiloxane dimethacrylate resin	1.1-1.5 µm	57% vol 76% wt
Beautifil II	SHOFU, Japan	031135	S-PRG filler	10-20 nm	83.3% wt

Twelve cylindrical specimens were made of each material using a stainless-steel mould (2 mm thick and 9 mm inner diameter). Each material was inserted directly into a mould with a plastic instrument. A microscope glass slide (Mariefeld, Germany) interposed with a cellulose matrix strip (PN 1148, SHOFU, Japan) was placed on the composite resin to avoid air inhibition layer (oxidizing layer) and to obtain a smooth surface with the polish of natural resin. Finger pressure was used for 30 seconds, to remove the excess and obtain a flat surface. After this time, the pressure was removed. The specimen was polymerized in accordance with the manufacturer's recommendations, i.e. 40 seconds, covering the total area with a high intensity visible light (LED) source

(Guilin Woodpecker medical instrument Co. Ltd, Guangxi, China) with an output of 800 mW/cm2 at all times keeping the tip as close as possible to the resin surface and perpendicular to the restoration surface (by touching to the surface of glass slab at all times). The output from the curing light was periodically monitored with a curing radiometer (DigiRate radiometer, LM-100, Monitex, Taiwan). Polymerizing the composite materials against a glass surface is a method commonly used by researchers to produce a standardized surface finish for testing (Tanoue *et. al.,* 2000). The chosen technique excluded air from the composite surface and thereby minimized oxygen absorption to produce an oxygen-inhibition layer. The degree of attenuation of the high–intensity curing light due to the borosilicate microscope slide (1 mm thick) was judged to be negligible. To reduce variability, the same shade of composite materials (shade–A3) was used and operated by the same operator. The specimens were examined for obvious voids, bubbles, and surface imperfections with handy magnifying glass (magnification × 3). The specimens were labeled on the bottom.

The samples were stored in distilled water at 37 degree centigrade for 24 hours to allow completion of polymerization reaction. Moreover, they would get hygroscopic expansion and would not absorb dentifrice slurry during tooth-brushing test.

Thereafter, the specimens were polished with wet 800- grit, followed by 1000-, 1200- , 1500- and 2000 grit silicon carbide waterproof electro coated abrasive papers in a polishing machine under running water to obtain a plane, smooth and glossy surface. Each grit was ground for 10 sec. The rationale for the use of 2000 grit silicon carbide paper is to produce an optimally polished surface and to have a comparable initial roughness which allowed us to better assess the materials' roughness as well as to remove the oxidizing layer. After finishing and polishing, specimens were rinsed with running tap water. Then ultrasonic cleaning of the polished specimens was performed for 3 minutes in water to remove any surface debris. Afterwards, each specimen was dried with absorbent paper to remove excess water. And then each specimen was dried with gentle air. To ensure the dryness, the specimen was placed in air for 24 hours. All the procedures were performed under ambient light and temperature.

The initial weight measurement was done on digital scale with 0.001 g accuracy. The samples were weighed every 24 hours during 2 weeks until they reached a constant weight on three consecutive days of measurements. The mean of the last three measurements was considered as the baseline weight. This initial calculated weight was expressed as W1.

In order to study the appearance of the polished and finished surface of the specimen as a baseline, a scanning electron microscope was used. Scanning electron microscopy (SEM) has been largely used in dentistry to study surface characteristics of different materials. Only two samples for each group which Ra values tested by surface roughness tester are closest

to mean value were selected.

The surface of the specimens was sputter-coated with platinum and then observed using a scanning electron microscope (JEOL JSM – 5610 LV, Japan) with a magnification of 550× and 5500×. To evaluate the same specimen after toothbrushing, the palladium sputter was removed with alcohol before submitting the specimen to the toothbrushing device.

The samples were identified and subjected to the mechanical tooth brushing test. Each specimen was fixed on a specimen holder attached to a toothbrush abrasion testing machine. In tooth brushing simulating machine, Oral B electric tooth brush (Oral B: Advance Power 400, powered by BRAUN, Germany) was fixed to the apparatus and kept alongside the samples, using slurry of Colgate® Total 12 Clean Mint dentifrice with deionized water in a ratio of 1:2 by weight, according to the ISO specification (cited in Mondelli, 2005).The dentifrice was placed between the brush and the surface of the material to maintain constant supply of abrasive during brushing. The water level of the slurry was kept high enough to ensure that the brushing surface was under the dissolved dentifrice. The dentifrice slurry was regularly changed after 100 minutes of brushing time which is clinically equal to one year age. The slurry pH was checked during the test (between 7.0 and 7.4). Simulated toothbrushing was performed with rotation and oscillation action (oscillating at 7,200/min). Bristles are flexisoft and colour fade was indicated to replace brushhead. In the present study, each brushhead was used for only one specimen. The test was made under a load of 350 grams, to simulate the force of tooth brushing procedures. Each specimen was brushed for 200 minutes (3 hours and 20 minutes). According to Heintze's work (2010), this period is clinically equal to two years age of toothbrushing. Following the test, the specimens were removed. Specimens were rinsed with running tap water to remove surface debris and ultrasonically cleaned with water for 3 minutes. And then each specimen was dried with gentle air. To ensure the dryness, the specimen was placed in air for 24 hours. Final roughness measurements were made according to initial measurement protocols. The measured final roughness data was expressed as R2.

The roughness alteration (changes in surface topography) was observed by the difference between baseline and final reading means. In order to study the changes in surface topography of different composite resins after toothbrushing, a scanning electron microscope was used. For each group, Ra values which were nearest to the mean values were selected. The wear resistance was evaluated through the averages of surface roughness. This study was approved by Research and Ethical Committee of University of Dental Medicine, Yangon.

Statistical Analysis

The data was statistically analyzed by one way analysis of variance (ANOVA) and Tukey's post hoc test to evaluate the difference among the tested materials. Paired Sample T test was used to evaluate the surface roughness changes after simulated toothbrushing. The results were

analyzed by calculating the mean and standard deviations for each experimental group.

Figure 1. Specimen preparation

Figure 2. Polishing Machine

Figure 3. Digital Jewelry Scale Item No. FC 50, China

Results

The average of weight loss and weight loss percentage of the different tested composite resins after simulated toothbrushing is presented in Table 2 and Figure 4. Table 3 presents the results of materials weight loss and Figure 4 graphically depicts the weight loss percentage for each experimental group.

Table 2. Means of initial weight, final weight, weight loss and weight alteration %

Materials	Initial Weight (gm) W_1	Final Weight (gm) W_2	Weight loss (gm) $W_1 - W_2$	Weight alteration % (Mean ± SD)	P value
Denfil	0.3718 ± 0.0291	0.3695 ± 0.0289	0.0023 ± 0.0011	0.6268 ± 0.2817	<0.01
Admira	0.38 ± 0.1058	0.3767 ± 0.1051	0.0033 ± 0.0013	0.8656 ± 0.3528	<0.01
Grandio	0.379 ± 0.0431	0.3764 ± 0.0431	0.0026 ± 0.0011	0.6889 ± 0.2960	<0.01
CeramX mono	0.3877 ± 0.0669	0.3861 ± 0.0667	0.0016 ± 0.0008	0.4341 ± 0.1979	<0.01
Beautifil II	0.3467 ± 0.0735	0.3440 ± 0.07423	0.0027 ± 0.0022	0.8415 ± 0.7804	<0.01

Paired Sample T test (n=12 for each group)

Table 3. Comparison of weight loss alteration before and after simulated toothbrushing by Tukey's post hoc test

Multiple Comparisons

Dependent Variable: weight loss
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Denfil	Admira	-.2387	.17696	.662	-.7378	.2604
	Grandio	-.0618	.17696	.997	-.5609	.4373
	Ceram X mono	.1927	.17696	.811	-.3063	.6918
	Beautifil II	-.2146	.17696	.744	-.7137	.2845
Admira	Denfil	.2387	.17696	.662	-.2604	.7378
	Grandio	.1768	.17696	.855	-.3223	.6759
	Ceram X mono	.4314	.17696	.121	-.0677	.9305
	Beautifil II	.0241	.17696	1.000	-.4750	.5232
Grandio	Denfil	.0618	.17696	.997	-.4373	.5609
	Admira	-.1768	.17696	.855	-.6759	.3223
	Ceram X mono	.2546	.17696	.606	-.2445	.7537
	Beautifil II	-.1527	.17696	.909	-.6518	.3463
Ceram X mono	Denfil	-.1927	.17696	.811	-.6918	.3063
	Admira	-.4314	.17696	.121	-.9305	.0677
	Grandio	-.2546	.17696	.606	-.7537	.2445
	Beautifil II	-.4073	.17696	.160	-.9064	.0918
Beautifil II	Denfil	.2146	.17696	.744	-.2845	.7137
	Admira	-.0241	.17696	1.000	-.5232	.4750
	Grandio	.1527	.17696	.909	-.3463	.6518
	Ceram X mono	.4073	.17696	.160	-.0918	.9064

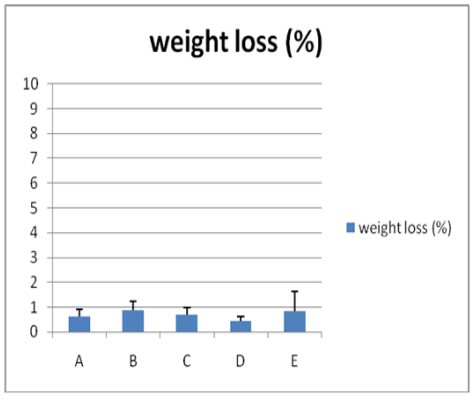

Figure 4. Percentage of weight loss of experimental composite resins after simulated toothbrushing. (Mean ± SD) (Error bars denote standard deviation).
(A.Denfil,B.Admira,C.Grandio, D.Ceram X mono, E.Beautifil II)

Scanning Electron Microscope (SEM) Observation

The surface topography of all tested composite resin materials before and after simulated toothbrushing wear were compared in Figure – 2.A, B, C, D, E. The SEM microphotographs in Figure 3 illustrate the surface texture of tested resin composites based on surfaces pre-ground with 800, 1000, 1200, 1500, and 2000 – grit SiC paper respectively (done as finishing procedure before simulated toothbrushing) and surface wear after simulated toothbrushing.

Generally, all composite groups tested in this study exhibited rougher surface texture after toothbrushing. When observing the images of SEM before toothbrushing, Denfil and Admira groups revealed the grinding scratches on the surface owing to finishing procedures. Moreover, some area of surface of Admira presented grooves and facets. Remaining three groups showed no scratches and mostly smoother surfaces than previous two resins. However, exposure of inorganic filler particles which distributed homogenously in different shapes and sizes was detected. Among the tested materials, fillers of Ceram X mono was the smallest in size and homogenously distributed, although Grandio and Beautifil II distributed irregular and larger filler particles and among them nano sized particles were filled. In addition, some areas of SEM images showed voids appearance. When observing the images of tested materials after simulated toothbrushing, a combination of filler exposure, loss of inorganic particles and resin matrix wear were detected. When analyzing the size of holes and craters, there was no broader than filler particle sizes. Hence, it may be due to exfoliation of filler particles. However, in case of Denfil and Beautifil II, there may be occurred a few larger holes, it may be due to dislodging of filler particle and resin matrix couple clusters.

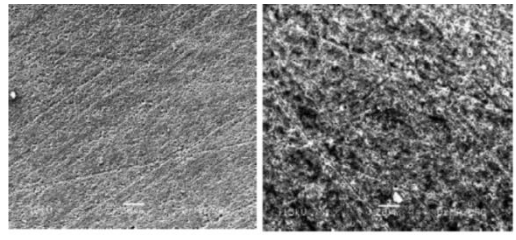

Figure 5. SEM microphotographs of Denfil composite before and after simulated toothbrushing wear (550×)

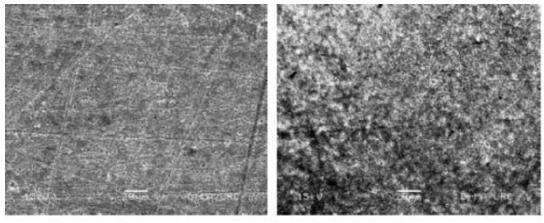

Figure 6. SEM microphotographs of Admira composite before and after simulated toothbrushing wear (550×)

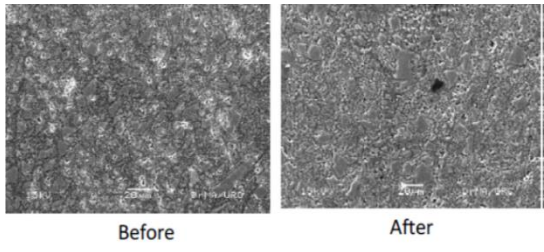

Figure 7. SEM microphotographs of Grandio composite before and after simulated toothbrushing wear (550×)

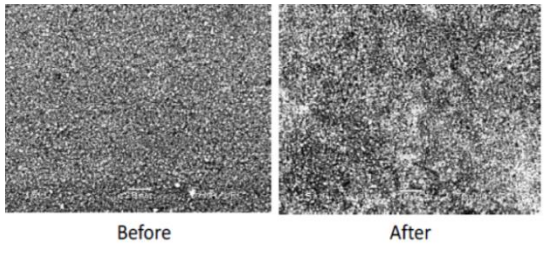

Figure 8. SEM microphotographs of Ceram X mono composite before and after simulated toothbrushing wear (550×)

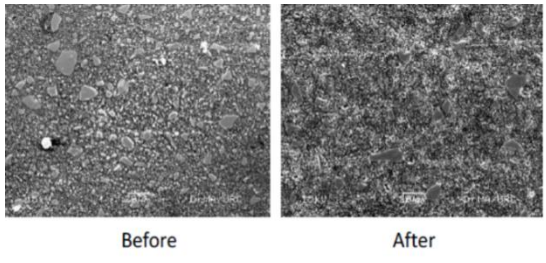

Figure 9. SEM microphotographs of Beautifil II composite before and after simulated toothbrushing wear (550×)

Discussion

The simulated toothbrushing abrasion with dentifrice slurry caused significant weight loss and surface roughening for all tested resin materials. When analyzing the differences of weight loss alteration among the tested groups, Ceram X mono presented the lowest value of weight loss alteration and in increasing order, Denfil, Grandio, Beautiful II and Admira, however, there was no statistically significant difference among them ($p>0.05$).

Wear of composite resins could be measured based on the level of weight loss alteration (Rios, et. al., 2002). Although a significant weight alteration after the simulated toothbrushing wear was detected for all tested composite groups, resultant outcomes were less than 1%. Therefore, it is difficult to predict whether an average loss of 1% could contribute to long term alteration of anatomic form of restorations. However, from a clinical standpoint, Moraes, *et.al.*, (2008) reported that the roughening effect could be rather significant, and the materials with finer particles showed lower roughening. Similar findings of the present study agreed with their results except for Beautiful II (Giomer) material.

Concerning with Beautifil II composite (Giomer), while analyzing with profilometer, its surface roughness was the least among the tested groups, although there were no statistically differences between Grandio, Ceram X mono and Beautifil II ($p>0.05$). However, when measuring the weight loss percentage, it showed the greatest value. Hence, it can be found that this material had the least

wear resistance to simulated toothbrushing. Possible explanation is related to its composition and setting reaction. Giomer has two distinct setting reactions: glassionomer setting reaction as well as resin matrix polymerization. During setting mechanism of glassionomer, it absorbs water which creates a softer surface. Moreover, Giomers are based on PRG technology in which pre-reacted glass ionomer cement are used as fillers. PRG fillers are obtained by reacting acid reactive fluoride containing glass with polyacids in the presence of water. Hence, its glass filler' nature is softer than that of conventional composite resin. Therefore, toothbrushing may uniformly abrade filler particles and polymer matrix which leads to the smoothest surface, but unfortunately presents the highest weight loss alteration. This finding discloses the fact that Beautifil II composite resin requires further improvement in mechanical properties before it can be considered as serious competitor to conventional resin composite materials as aesthetic restorative materials.

Composite resins have a mixed structure consisting of soft matrix resin and hard filler particles. Unfortunately, there usually is a problem during the toothbrushing. Since the resin matrix and inorganic filler differ in hardness, surface of the composite resins are not abraded uniformly. After tooth-brushing, soft matrix resin was firstly worn and the dislodgment of filler particles was caused by long-term use (Tanoue, *et. al.*, 2000). Moreover, Roulet (1987) reported that abrasive wear is a result of the third body cutting action gradually removing the soft resin matrix between the filler particles and leaving the filler phase in a positive surface. The SEM finding of the present study supports this phenomenon. Simulated tooth-brushing created scratches on the surfaces of denfil composite and plucked the particles away, while a uniform smooth surface could be generally obtained in remaining groups. However, the roughness values were not the same for these groups.

While studying the SEM microphotographs of tested composites after simulated tooth-brushing, a seemingly rather smooth surface was achieved for Admira at 550× magnification, but examination at 5500× magnification revealed a less homogenously abraded surface and the exfoliated small filler particles and created the crater like area.

Therefore, after the simulated toothbrushing with dentifrice slurry, the surface texture of all tested resin materials were apparently abraded under scanning electron microscopic examination. With the present outcomes, we agree with the results of Strassler's study (1988) in which he reported that toothpastes can affect composite smoothness. Scanning electron microscopic (SEM) analysis appears to be an efficient and acceptable method of examining such features as surface topography, filler size and distribution, interface adhesion and porosity. The SEM can be used to detect the mode of failure, investigate mechanisms of wear and surface changes and study the surface conditioning and improvements (cited in Xie, 2000). Furthermore, Ergucu and Turkun (2007) observed that profilometric measurements were

largely confirmed by SEM analysis.

While observing the SEM micrographs of the tested materials after the simulated toothbrushing, nanohybrid resins, (Grandio and Ceram X) revealed lesser values of surface roughness than that of microhybrid resin (Denfil). It was agreed with the work of Oliveira *et al.*, (2012) where they reported that the qualitative analysis of the SEM micrographs of the resins, after the abrasion test, showed more polished surface of the nanofilled and the nanohybrid resins than the microhybrid resins. In addition, they proved that Admira (Ormocer based composite) was significantly rougher than the nanofilled composites.

In this aspect, the most likely cause of the improved abrasion resistance of the nanohybrids in comparison with microhybrid counterpart lies in differences between filler technologies of these materials. Filler particles should be situated as close together as possible in order to protect the resin matrix from abrasion. The application of nanotechnology to composite research is of great benefit. Due to reduced dimension of the particles and wider distribution, an increased filler load can be achieved, which results in reducing polymerization shrinkage and increasing mechanical properties (Terry, 2004).

Manhart *et al.*, (2000) and Tanoue *et al.*, (2000) mentioned that wear resistance of composite resins could be influenced not only by filler content and size but also by other factors such as matrix-filler interaction. In addition, five possible mechanisms for wear in composite resins: wear of the resin matrix, loss of fillers by failure of bonding to the matrix, loss of filler through shearing of exposed particles, loss of filler through cracking and failure of the matrix; and exposure of entrapped air bubbles (cited in Xie, 2000). The apparent contrast, particularly, between Admira and Grandio may be due to compositional differences in resin matrix and the filler, although they were produced by the same manufacturer. Differences in resin matrix composition may cause the variation in degree of conversion resulting in the different degree of wear. In general, resin matrix was composed of various amounts of Bis – GMA, Bis – EMA, UDMA, TEGDMA according to manufactures' formulations. Depending upon the percentage of TEGDMA, there may be changes in degree of conversion and plasticization (Filho *et al.*, 2008).

In the present study, nano groups showed less surface wear changes than other groups except Giomer (Beautifil II). By understanding how particle size, distribution, and volume affect the mechanical properties of composite resins, the clinician can accurately diagnose and treat a patient's condition by selecting the appropriate composite resin restorative material. The assessment of the materials in the present study presented different outcomes for surface roughness changes, and it is clear that the mechanisms accounting for these phenomena are more complex than can be explained by filler component alone. Other factors should be also considered. Nevertheless, the conditions established here did not take into account the effects such as variations in pH, composition and temperature of saliva, food and

beverages that can fluctuate in the oral cavity, the presence of plasticizing agents and mechanical fatigue such as sliding, abrasion, and the interaction of other stresses that could be encountered in the clinical situation.

It must be acknowledged that this study has several limitations. First, the *in vitro* nature of the present experimentation may limit, at least in part, its applicability to clinical practice. For example, present *in vitro* study correlates only to clinical situations in which there are accessible and relatively flat surface. Hence, the selection of the most appropriate material under these circumstances was recommended, the results obtained both from *in vivo* and *in vitro* should be evaluated together.

Conclusion

Simulated toothbrushing caused slight increase in surface roughness value and slight reduction of weight of all tested resin samples. Beautifil II could not resist the wearing process and occur more weight loss than Ceram X mono due to their intrinsic properties of chemical composition. Ceram X mono, one of nanohybrid, is the most reliable aesthetic restorative material that can resist toothbrushing wear comparatively within the limitation of present study. The analysis of differences in surface roughness and weight loss before and after the simulated toothbrushing may provide some further basis for a rational choice of the most appropriate composite resin material.

COI

The authors declare there is no potential conflict of interest.

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Comparison of Retention, Interfacial Surface Tension, of Maxillary Complete Denture Base Plates Processed by Conventional Molding Technique and Injection Molding Technique

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***Abstract* - The material of choice and the processing technique play an important role in palatal adaptation and retention, of the complete denture. The purpose of this in vivo study was to compare the retentive forces between maxillary complete denture base plates fabricated by compression molding and injection molding techniques in the same patient. A total of 12 maxillary edentulous patients (24 complete denture base plates) comprising male and female were included in this study. Their age ranged from 40 to 80 years with the mean age of 65 years. Two maxillary complete denture base plates were constructed for each patient by using different molding techniques. The clinical outcomes of retention of both molding techniques were measured with Analog Push-Pull gauge. Data were analyzed by Wilcoxon singed ranks test. The mean retentive values were 24.94 Newton (N) and 20.48 N for injection molding and compression molding technique respectively. The retention of denture base plate processed by injection molding technique was significantly higher than that of processed by conventional technique (p<0.05). From the results of this study, it can be concluded that injection molding technique provides better retentive denture base than compression molding technique in complete denture construction.**

Keywords: injection molding, compression molding, complete denture, base plate, retention

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Introduction

Polymethyl methacrylate (PMMA) is the material of choice for a successful denture base due to its optimal physical properties, excellent esthetics and low toxicity compared to the other denture base materials. Conventional molding technique, pack and press technique, is widely used for fabrication of polymethyl methacrylate (PMMA) acrylic dentures.

Although this technique has been used till now, it has some significant disadvantages such as increased vertical dimensions (Matsuda, 2014), higher porosity, spherical deformation, higher acrylic shrinkage, inaccurate fit of the material to the master cast and larger amount of residual monomer (Dogan,1995). In 1942, Pryor

introduced injection processing of poly methyl methacrylate in order to reduce acrylic shrinkage. Patients' comfort is guaranteed by the precise fit of the acrylic dentures as well as minimum level of residual monomer and easy maintenance.

Moreover, one of the basic purposes of each processing technique of complete denture is to produce a perfectly fitting denture with minimal fabrication distortions. An *in vitro* study confirmed the better denture base adaptation of injection processing technique compared to pack and press technique (Goodacre, 2016). However, there is no *in vivo* study for the denture base retention between conventional molding method and injection molding method. The purpose of this study was to compare the retentive forces of maxillary complete denture base plates processed by two different molding techniques in the same patients.

Material and Methods

Study design: clinical comparative study

Study area: Department of Prosthodontics, University of Dental Medicine, Mandalay

Study population: Maxillary edentulous patients who came to the Department of Prosthodontics, University of Dental Medicine, Mandalay

Sample size: 12 subjects

Inclusion Criteria

- Age ranged 40 to 80 years old
- Both genders with good physical and mental health
- Subject with no pathological changes in denture bearing area

Exclusion Criteria

- Patients with major psychological disorders
- Patients with palatal torus and severe bony undercut

All subjects were thoroughly explained about the study procedure and taken consent to participate in this study. All study procedures were performed according to the Helsinki Declaration; Ethical principles for medical research involving human subjects developed by World Medical Association.

Study Procedure

On the patient's first visit, primary impression was made by using irreversible hydrocolloid impression material (Jeltrate, normal set, China) with perforated stock tray. The impression was poured into cast by Plaster of Paris (POP) with standard ratio and method. Close fitting special impression tray was constructed by using light- curing acrylic resin tray material (Cavex LC Dental Tray, Germany). On the second visit, try in the tray on the maxillary ridge of the patient and the peripheral tracing was done by green stick compound. After peripheral tracing, secondary impression was made with Zinc Oxide Eugenol impression materials (Cavex Outline, Holland). After that the impression was boxed in and pouring the cast with type IV dental stone (Dentamerica). And then duplicate the cast with silicone impression material (Vonflex S Putty and Light body, Korea). Two wax denture base plates were constructed on each cast and

fabrication of two maxillary acrylic complete denture base plates by using both conventional and injection molding processing techniques (QC-20 Denture Material, England).

Figure 1. Snow Rock Jetpack injection machine (Korea)

A total of 24 maxillary complete denture base plates were made by using compression molding and injection molding processing techniques for 12 patients. In the center of each denture, a retention ring was temporary fixed for providing a point of application to test retentive force. This ring was fabricated by stainless steel wire 0.8 mm and fixed with self cured acrylic resin.

Figure 2. Total of 24 maxillary complete denture base plates for 12 maxillary edentulous patients

The magnitude of dislodging force was measured by using Push-Pull gauge which attached to retention ring and pull the denture base plate with direction perpendicular to the occlusal plane.

Figure 3. Handy Analog Push-Pull Gauge

The results were subjected to statistical analysis with paired t test. Significance value (*p*) was found out using the Test of Significance.

Results

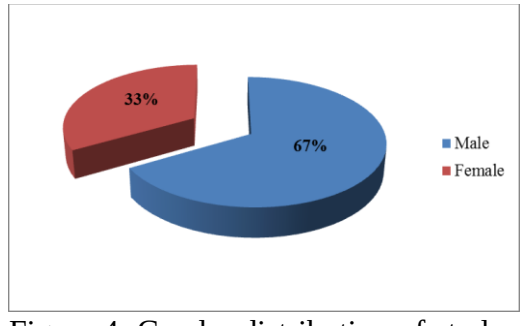

Figure 4. Gender distribution of study population

This figure represents the percent distribution of male and female subjects in this study. (Male = 67%, n = 8, Female = 33%, n = 4)

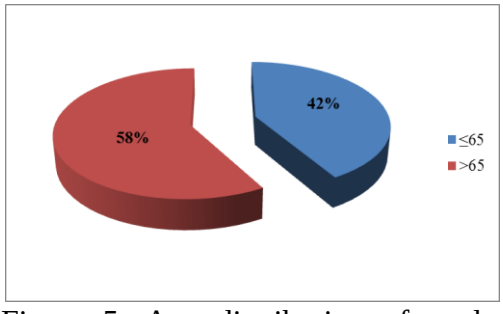

Figure 5. Age distribution of study population

The pie chart showed age group distribution of the study population. Among the 12 study patients, 58% of the study population were above 65 years and most of the patients were geriatric in this study.

Table 1. Comparison of mean retention force of denture bases produced by conventional molding and injection molding methods (n=24)

Variable	Mean (SD)		*Z* statistic	*p**
	Injection	Com-pression		
Retention (N)	24.94 (14.73)	20.48 (13.82)	-2.436	0.015

*Wilcoxon singed ranks test

The *p* value is < 0.05 and thus, there is significant difference of mean retention force between injection and compression molding methods.

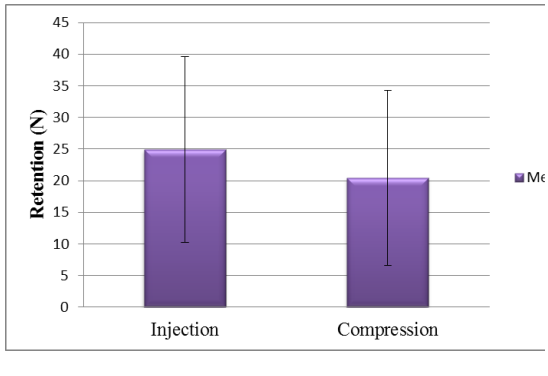

Figure 6. Mean retention of injection molding and compression molding techniques

Discussion

In this study, most of the complete denture patients were geriatric patient and the complete denture is a definitive prosthesis for treatment of edentulous geriatric patient. Moreover, complete denture retention is a major problem for this age group because of their aging residual alveolar ridge. For complete denture retention, peripheral seal, interfacial seal and posterior palatal seal are the three main factors for upper complete denture retention. In this study, the retention of two denture base plates processed with two different molding techniques for the same patient were studied. Same peripheral tracing impression method for peripheral seal and same post dam design for posterior palatal seal were constructed for each patient to reduce the variables. Therefore, the denture processing technique remains the only factor that can affect the retention of the denture base plates.

In this study, the retention of denture base plates processed by injection molding technique was statistically higher than that of denture base plates processed by compression molding technique. It may be due to the constant pressure of injection molding technique. In compression molding technique the material was packed into the flask and then the pressure was applied. Hence, when there is polymerization shrinkage there was no excess unpolymerised material to compensate for shrinkage. In injection molding technique the flask was held at a pressure and later the

material was injected slowly into the flask at a constant pressure until the polymerization was completed. This slow injection of material at a constant pressure helped to compensate for the shrinkage of the material. Therefore, precise adaptation of poly methyl methacrylate to the master cast can be result. In addition, the dentures produced by injection molding technique were aesthetically more fine, homogenous and no porosity.

According to the *in vitro* study of Lee in 2010, the adaptation accuracy of acrylic denture base processed by fluid-resin (PERform) and injection molding (Mak Press) produced significantly smaller palatal gap dimension than the two injection moldings (SR-Ivocap, Success) and two compression molding techniques. It was found that different materials and techniques can give different results. Moreover, new denture materials and new denture processing techniques are continuously introduced in dentistry as the technique for denture fabrication are still unfulfilled. More retentive complete denture base is needed for reducing initial adaptation period of denture wearer and patient's satisfaction. Therefore, a further method for comparing the denture base retention and accuracy of the complete denture with patients' perception is needed.

Conclusion

The injection molding technique (Snow Rock) produced more retentive and aesthetic denture than the standard compression molding technique. It also messages to both clinicians and laboratory technicians about reliability of injection molding denture base fabrication technique.

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The authors declare there is no potential conflict of interest.

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Oral Health Status, Treatment Needs and Oral Health Behavior among Pregnant Women who Attending Antenatal Clinics in Mingalardon Township

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***Abstract* – The aim of the study was to assess the oral health status, treatment needs and oral health behavior among 18 to 35-year-old pregnant women who attending antenatal clinics in Mingalardon Township, Yangon Region. Cross-sectional descriptive type of study was carried out among 257 pregnant women in 2 urban and 3 rural health centers. Sociodemographic characteristics and oral health behavior were collected by face-to-face structured interview method. Intra-oral clinical examination was performed to assess dental caries status and treatment needs by using DMF-T index and gingival status and treatment needs by using CPITN index according to WHO criteria. Participants were likely to be from middle socio-economic community, one-third of participants (31.9%) reported that they were graduated and three quarte of total sample (73.9%) were dependent. Participants seem to have good oral hygiene behavior, reporting almost all brush their teeth with toothbrush and toothpaste and 84.0% reported that they used fluoridated toothpaste. History of dental visit was answered from 22.9% of pregnant women and the main reason of visit was pain and discomfort. Dental caries prevalence was 44.74% with mean DMF-T of 0.92 (1.30). The prevalence of gingival bleeding was 48.2% with MNS of gingival bleeding was 1.13 (1.53). Concerning with treatment needs, simple dental procedures like restorative treatments, scaling and OHI will fulfil most of the cases. Only 5.05% of women required dental extraction. Dental caries prevalence was not related to education level but highly educated group had better gingival status. Participants who had visited dentists had higher prevalence of dental caries lower prevalence of gingival bleeding. The present study might indicate that a substantial positive impact of oral conditions in this population group. The present findings could reflect current situation of oral health status, dental treatment needs and oral health behavior among pregnant women which will be useful in future planning and strengthening oral health promotion program not only for expected mother but also for the whole women population. This will**

definitely improve the oral health of upcoming generation in Myanmar.

Keywords*: *Oral health status, Dental treatment needs, Oral health behavior, Pregnant women

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Introduction

Oral health is a fundamental component of health and it includes the ability to speak, smile, smell, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without pain, discomfort and disease of the craniofacial complex. Oral diseases are not only the markers for underlying health problems, but also important determinants influencing the development of certain health conditions such as diabetes, cardiovascular disease and adverse pregnancy outcomes (Anil & Al-Ghamdi, 2006).

Pregnancy is a natural process with considerable physiological and hormonal changes in women's body, including oral cavity. Oral health condition during pregnancy is important to general health of both mothers and infants and poor maternal oral health can have negative impact for both mothers and their newborns (Marla *et al*., 2018). Hormonal changes during pregnancy causes oral problems, mainly related to the gingivitis and periodontitis. Estrogen and progesterone receptors in gingival may cause the increased gingival oedema and gingivitis in around 50% of pregnant women (Figuero *et al.*, 2013).

There are many common oral problems in pregnancy such as pregnancy gingivitis, pregnancy epulis, tooth erosion, tooth mobility, dental caries and periodontitis. As evidence showed that poor oral hygiene and oral health behavior during pregnancy can have negative outcomes for both mothers and their newborns, women should be given proper oral health promotion and oral health preventive measures before, during and even after birth (Ha *et al*., 2016; Corbella *et al*., 2016).

Adverse pregnancy outcomes represent significant problem in both developing and developed countries. Among 136 million babies born every year, approximately 4 million are stillborn. In 2006 Worldwide, 12% of babies are born prematurely, 8% with low birth weight and 3% with major birth defects (Althabe *et al*., 2012). Among several determinants of adverse pregnancy outcomes, oral health status during pregnancy especially periodontal condition may have association with these unfavorable pregnancy outcomes.

Nevertheless, pregnant women may not be aware of the effects of their oral health on the fetus and their pregnancy outcomes (Abati *et al.*, 2004). And also, women want to avoid visiting dentists and getting dental treatments during pregnancy as they fear of the dentist, the possibility of feeling pain and discomfort due to environment of the dental clinic. Moreover, pregnant women may concern about their fetal safety (Kandan *et al.*, 2011).

However, pregnancy is a time when women may be motivated to make healthy changes (Kumar &

Sameleson, 2007). So, some of the health behaviors women may need to initiate, maintain, modify during antenatal care (eg. correct tooth brushing method, dental flossing, sweet consumption). Maintaining oral health during pregnancy may be achieved by early screening and referring pregnant women to oral health care practitioners for check-up (Charlene & Mervyn, 2019).

Oral health promotion has also been increasingly focused on pregnant women since they multiply attitudes within the family, influencing in her child as well as on her family's oral health behavior and also in the family's eating and hygiene habits (Leal *et al.*, 2006). Furthermore, early childhood is the ideal period for introducing good habits and adopting behavioral pattern that may remain for the whole lifetime of individual child (Lilian *et al*., 2014).

Many studies have reported with varying caries and gingivitis prevalence in pregnant women and Noochpoung *et al*., (2010) reported that caries experiences in pregnant women in Thailand was 74.0% and gingivitis was 86.2%. Oral health in Bangladesh pregnant women was assessed by Rahman *et al*., (2013) and it was found that 87.3% had caries and 94.1% had gingivitis respectively. Gupta and Acharya, (2016) performed a study on oral health status and treatment needs in Indian pregnant women and found that 62.7% had caries and 94% had gingivitis.

Few studies on the oral health among pregnant women were presented in Myanmar. Than Than Aye (1998) studied the oral health status and Knowledge, Attitude, Practice (KAP) level of pregnant women attending three women central hospitals and reported that 56% had caries and 23.3% of the pregnant women had gingivitis. Saw Nandar Aung (2016) studied the oral health status of the postpartum women in Thingangyun Sanpya Hospital and presented that 53.5% of Myanmar postpartum women had caries and 8.1% had gingivitis.

There were many studies concerning with general health as well as reproductive health being carried out and presented by doctors and nurses in Myanmar. Data on oral health status, treatment needs and oral health behaviors among pregnant women in Myanmar are still necessary for the planning of oral health care services in the Ministry of Health (MOH). Researchers in dentistry also recommended that oral health data and pattern of some oral health related behavior of pregnant women were important for planning and implementation of oral health promotion program not only for mothers of present time but also for the whole future family in Myanmar. Therefore, the present study was carried out to study the oral health status, treatment needs and oral health behaviors among pregnant women in one selected township in Myanmar. Any associations between the socio-demographic data and oral health status as well as treatment needs of pregnant women were also assessed in this study.

Materials and Methods

A cross-sectional, descriptive, non-intervention type of study was carried out in 2 Urban Health Centers (UHC) and 3 Rural health Centers (RHC),

Mingalardon Township, Yangon Division during 2021. Ethical approval was granted from the Institution Review Board of University of Dental Medicine, Yangon. The examiner contacted township health authorities of Mingalardon Township and explained about the purpose of the study and asked permission.

As the study was carried out during the pandemic of Coronavirus Disease 2019 (Covid-19), all the pregnant women who were attending antenatal care in Mingalardon Township were referred to Covid Center in Mingalardon Township for Rapid Diagnostic Test (RDT) of Covid-19 virus. Only the pregnant women resulted with negative RDT came back to respective UHCs and RHCs and attended antenatal care. That means all the participants in this study were negative of Covid-19.

Oral health data for present study were collected in first three weeks of November, 2021. The incidence of new Covid-19 cases was reasonably low during this period.

With the help of Basic Health Service Professionals (BHSP) of Mingalardon Township, 18 to 35-year-old pregnant women who attending Health Centers were selected according to the inclusion and exclusion criteria. Then, they were explained about the detailed procedure of the study and asked for consent. Total of 257 pregnant women participated.

After getting the consent, pregnant women were asked for socio-demographic characteristics and oral hygiene behavior by face-to-face structured interview method using questionnaire. Intraoral examination was performed to assess dental caries status by using DMF-T index and gingival status by using CPITN (WHO, 2013). Disposable oral examination set was used for each participant during clinical examination.

After data collection, oral health education pamphlets and tooth brushing kits were presented to participants. Pregnant women who required dental treatments were referred to Mingalardon Public Health Center.

Data analysis was performed by using Statistical Package for Social Science (SPSS) (version 20). The continuous variables were expressed by the mean and standard deviation and analyzed by Student's *t*-test and One-way ANOVA test. The categorical variables were described by frequency and percent and analyzed by Chi-square test. Level of significance was set at $p < 0.05$.

Results

In this study, 257 pregnant women (mean age 28.04 years, range 18 to 35 years) from two UHCs and 3 RHCs from Mingalardon Township were participated. Total sample comprised of 65 of 18-24 age group (25.3%), 68 of 25-29 age group (26.5%) and 124 of 30-35 age group (48.2%).

Table (1) presented the education attainments and occupation status among pregnant women and found that one-third of total sample (38.9%) answered that they completed high school education and another one-third (31.9%) were graduated. Concerning with education level, the present sample were likely to be from educated society. However, only 12.1% of them were government servants and almost

three-fourth (73.9%) responded that they were dependent.

All participants reported that they had tooth brushing habit. Nearly all of them (99.6%) brushed their teeth with tooth brush and toothpaste. Regarding with use of fluoridated toothpaste, 84.0% of pregnant women reported that they used fluoridated toothpaste and 14.0% of participants reported that they did not know whether the toothpaste they used contained fluoride or not. Concerning with use of dental floss, only 7.8% of the participants reported that they practiced dental floss (Figure 1).

Majority of the pregnant women (77.0%) presented that they had never visited dental clinic (Figure 2). Among the participants who visited dental clinic (n=59), majority of the participants (46 out of 59) (77.9%) stated "pain or trouble with teeth, gum" as their main reason to visit dentist.

Dental caries status and treatment needs of pregnant women were shown in (Table 2). Almost half of the participants (44.74%) had dental caries. However, very low level of mean DMF-T, 0.92 (1.30) was observed in this study. Decayed teeth were the dominant portion of DMF-T status. Very few of the participants (5.05%) needed extraction.

Gingival status and treatment needs of pregnant women are shown in (Table 3). The present study revealed that half of the participants had gingival problem, 48.2% presented with gingival bleeding. Concerning with periodontal treatment needs, participants with gingival bleeding may require only OHI or scaling and polishing or both.

According to table 4, participant's education was categorized into 3 groups, low education (illiterate to completed primary school), middle education (completed middle school) and high education (completed high school to graduated). Prevalence of dental caries was not significantly different among these three groups. However, significant difference was observed in mean DMF-T value among three groups. Prevalence of gingival bleeding was different between low, middle and high education groups. The same statistically significant difference was observed in mean number of sextant (MNS) data of both gingival bleeding and calculus. The low-level education group had higher mean DMF-T value as well as the worst gingival problem in comparing with other groups.

Higher prevalence of dental caries was observed among participants those who visited dentist than those who did not. Lower prevalence of gingival bleeding was observed among participants those visited dentist than those who did not. MNS of both gingival bleeding and calculus were lower in those who visited dentists than who did not (Table 5).

Table 1. Frequency distribution of education and occupation status of pregnant women

Attributes	Pregnant women n (%)
Education	
Illiterate	7 (2.7)
Primary school education	3 (1.2)
Completed primary school education	18 (7.0)
Completed middle school education	47 (18.3)
Completed high school education	100 (38.9)
Graduated	82 (31.9)
Occupation	
Unskilled	6 (2.3)
Government servant	31 (12.1)
Profession	1 (0.4)
Dependent	190 (73.9)
Merchant/ Seller	29 (11.3)

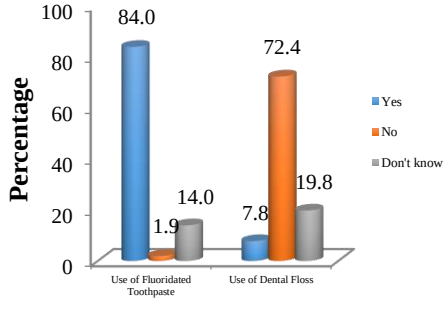

Figure 1. Frequency distribution of use of fluoridated tooth paste and use of dental floss (n=257)

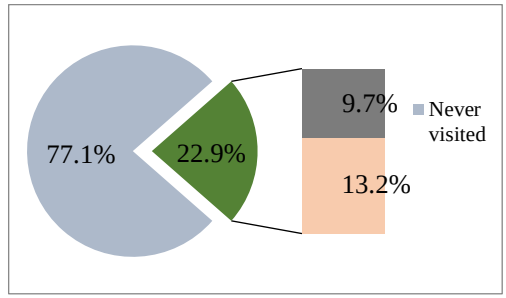

Figure 2. Distribution of dental visit behavior of pregnant women (n=257)

Table 2. Dental caries status and treatment needs among pregnant women (n=257)

Dental caries status and treatment needs		
Dental caries status	Prevalence of dental caries [n (%)]	115 (44.74)
	Mean D-T (SD)	0.63 (1.22)
	Mean M-T (SD)	0.00
	Mean F-T (SD)	0.31 (0.71)
	Mean DMF-T (SD)	0.92 (1.30)
Treatment needs	Subjects who need restorative treatment [n (%)]	109 (42.4)
	Subjects who need extraction [n (%)]	13 (5.05)

Table 3. Gingival status and treatment needs among pregnant women (n=257)

Gingival status	
Prevalence of gingival bleeding [n (%)]	124 (48.2)
MNS of gingival bleeding (SD)	1.13 (1.53)
MNS of calculus (SD)	1.24 (1.88)

Table 4. Relation between education and dental caries status among pregnant women (n=257)

	Education			*p*
	Low education (n=65)	Middle education (n=100)	High education (n=82)	
Prevalence of dental caries (%)	40.01	44.00	50.00	0.445*
Mean DMF-T (SD)	1.03 (1.57)	0.84 (1.23)	0.93 (1.30)	0.021**
Prevalence of gingival bleeding	60.0%	52.0%	32.92%	< 0.01^{+}
MNS of gingival bleeding (SD)	1.61 (1.90)	1.21 (1.43)	0.59 (1.03)	< 0.01^{++}
MNS of calculus (SD)	2.01 (2.14)	1.05 (1.80)	0.76 (1.49)	< 0.01^{+++}

*Not significant, Chi-square test
**Significant, One-way ANOVA test
+ Significant, Chi-square test
$^{++\ +++}$ Significant, One-way ANOVA test

Table 5. Relation between dental visit and dental caries status among pregnant women (n=257)

	Dental visit		*p*
	Yes (n=59)	No (n=198)	
Prevalence of dental caries (%)	77.96%	34.84%	<0.01*
Mean DMF-T (SD)	1.51 (1.12)	0.75 (1.30)	0.57**
Prevalence of gingival bleeding	28.81%	54.04%	<0.01^{+}
MNS of gingival bleeding (SD)	0.68 (1.23)	1.26 (1.58)	0.01^{++}
MNS of calculus (SD)	0.61 (1.36)	1.42 (1.98)	<0.01^{+++}

*Significant, Chi-square test
**Not significant, Independent sample t-test
+ Significant, Chi-square test
$^{++\ +++}$ Significant, Independent sample t-test

Discussion

The aim of this study was to assess the oral health status, treatment needs and oral health behavior among 18 to 35-year-old pregnant women in Mingalardon Township. A total of 257 pregnant women attending antenatal care in two UHCs and three RHCs were participated. Data relating to oral health status and oral health behavior were collected. The relationship between oral health status and oral health behavior of the pregnant women was identified in this study.

Concerning with sociodemographic status, one of the significant findings in this study was although two-third of the participants were highly educated (completed high school education and graduated). However, most of them reported as dependent assuming that participants

are likely to be from middle socioeconomic group.

Proportion of the participants using fluoridated toothpaste was higher in this study (84.0%) than in Maung Maung Myint (2013) study where 73.5% had knowledge of fluoride toothpaste. However, information about dental floss was poor, only a few participants (7.8%) reported they used dental floss.

Despite the fact that the oral health is important during pregnancy, the dental visit among pregnant women is still low. It might be because of misconception about the safety of her child and priority on other general health issues. In this study, only 22.9% had history of dental visit and the main reason was pain. Saw Nandar Aung (2016) also reported in her study that only 26.2% of postpartum women had history of dental visit. In a study carried out among Chinese pregnant women in Singapore by Balan *et al*., (2018), it was found that only 6.7% of participants visited dentist during pregnancy and the reason was only bleeding gum problem. So, it was similar condition with this study and they did not prioritize in getting the regular dental check-up. Therefore, establishing and strengthening of dental check-up should be implemented among pregnant women especially in developing countries.

In this study, almost half of the participants (44.74%) had experience of dental caries with the mean DMF-T of 0.92 (1.30) which included in very low category according to WHO data set. This result was much lower than the study done among pregnant women in Indonesia by Tedjosasongko *et al*., 2019, mean DMF-T of 4.34 with 84.7% caries prevalence. Compared to the study among postpartum women in Myanmar by Saw Nandar Aung (2016); 53.5% of caries prevalence with mean DMF-T of 1.83, the result in the present study is still low. However, inclusion of initial carious lesions in assessment of dentition status might give different caries figure.

For the treatment needs for dental caries of pregnant women, only a few participants needed extraction treatment. Therefore, the severity of the dental caries among pregnant women in this area might also be relatively low.

Almost half of the participants had gingival problem, 48.2% of participants had gingival bleeding. Compared to the study carried out among 18 to 26-year-old pregnant women in India by Gupta & Achrya (2016); with 95% of periodontal disease prevalence, MNS of gingival bleeding 0.8 and MNS of calculus 3.7, this study results were much lower. The results concerned with gingival bleeding in present study were higher than the study done in postpartum women in Myanmar by Saw Nandar Aung (2016), with (8.1%) of gingival bleeding. However, as hormone changes is one of the reasons for gingival bleeding in pregnancy, the higher results in this study may be due to it was carried out during pregnancy period.

The present study revealed that dental caries prevalence was not related to education level. A similar result was found in a study among Chinese pregnant women by Balan *et al*., (2018). However, significant difference of mean DMF-T value among three education groups was observed in this study i.e. higher

education groups had lower DMF-T value. This result was in accordance with the study among Palestinian pregnant women by Kateeb & Momany (2018), reported that participants who had completed a degree had lower DMF-T value than those who did not.

There was an association between participant's gingival problem and education, i.e. pregnant women who had completed high school had lower prevalence of gingival bleeding, MNS of gingival bleeding and MNS of calculus than those who had not. Similar result was reported in a study by Balgis *et al.*, (2016) that Saudi pregnant women with low education had higher gingival bleeding compared to pregnant women who had high education.

Pregnant women who had experience of visiting dentist had higher caries prevalence than those who had not. May be this was because of their main reason of visiting dentist, pain or trouble with teeth, gum. The same also found in gingival status data, higher level of gingival problems was observed among those who visited dentists. Thus, dental visit had somewhat advantages over gingival condition among the present sample. Oral health promotion program emphasizing the importance of regular dental visit should be encouraged among pregnant women.

There are some limitations in the current study. The study population was not representative for the national population because they were from only one township. This study does not establish a causal relationship between the variables as the data were from a cross-sectional study.

Even so, the results of this study could represent the data of current oral health status and oral health behavior among pregnant women which might be supportive in planning and strengthening oral health promotion program in pregnant women. Further study should be implemented among pregnant women in different geographical areas of Myanmar.

Conclusion

Low level of dental caries status and dental service use were observed among pregnant women in this study. Better gingival status was found among those who visited dentist and those with higher educational attainments. Establishing and strengthening of maternal oral health care emphasizing practicing of good oral hygiene behavior and regular dental checkup should be implemented for not only pregnant women but also for the whole women population in Myanmar.

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The authors declare there is no potential conflict of interest.

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A Study of Relationship between Orthognathic Functional Treatment Needs and Quality of Life in Patients with Dentofacial Deformities

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Abstract **- Index of Orthognathic Functional Treatment Need (IOFTN) is the index that categorizes severe malocclusions that are not amenable to orthodontic treatment alone according to prioritizing the treatment need. Orthognathic Quality of Life Questionnaire (OQLQ) is an instrument to estimate quality of life in patients who are undergoing orthognathic surgery. The aim of this study was to find out the relationship between the orthognathic functional treatment needs and quality of life in patients with dentofacial deformities. The sample consisted of 60 randomly selected patients with skeletal problems in the Department of Orthodontics, University of Dental Medicine (Yangon). It included 27 males and 33 females with an age ranged between 18-45 years. A cross-sectional analytical study design was used to find out the association between orthognathic functional treatment needs and quality of life in patients with dentofacial deformities. The IOFTN grading was determined by assessing the patients both extra-orally and intra-orally. The OQLQ scoring was collected by interviewing Orthognathic Quality of Life Questionnaire. Chi-square test was used in the data analysis. 80% of sample population fell into grade 4 and grade 5. There was a significant association between gender and quality of life especially in awareness domain. Males were more aware of their dentofacial esthetics. There was a significant association between age and quality of life especially in oral function. The older group had more functional problems. The result showed there was no statistically significant association between IOFTN and quality of life in patients with dentofacial deformities (*p* value-0.427). This study indicated that the evaluation of treatment priority for the dentofaccial deformity based on index of orthognathic functional treatment need alone could not be sufficient enough for deciding treatment need and quality of life should be encountered to achieve good decision for treatment priority.**

Keywords: Orthognathic Functional Treatment Need (IOFTN), Orthognathic Quality of Life Questionnaire(OQLQ),quality of life, dentofacial deformities

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Introduction

The term dentofacial deformity refers to significant deviations from normal proportions of the maxillo-mandibular complex that also negatively affect the relationship of the teeth within each arch and the relationship of the arches with one another (occlusion). The affected individual will have varied degrees of compromise in head and neck functions related to breathing, swallowing, speech articulation, chewing, and lip closure/posture. Effects on the temporomandibular joints, the periodontium, and the teeth themselves may also occur. The presenting facial disproportion will, in general, have at least some negative effects on psychosocial health (Posnick, 2014).Improvements in facial esthetics have been considered the main motivating factor for patients seeking orthosurgical treatment (Soh & Narayanan, 2013).

Angle stated that the only possibility of treating true dentofacial deformities was to combine orthodontics with surgery; and recognized the importance of combining effects of in these two approaches of dentofacial disharmony in patients with skeletal conditions (Angle, 1903). In late 2013, NHS England published its interim clinical commissioning policy for orthognathic treatment. The use of Index of Orthodontic Treatment Need (IOTN) has limitations as a measure of functional and health need in orthognathic treatment provision. In particular, some severe dentofacial deformities and malocclusions would not be eligible for NHS funding for orthognathic treatment using IOTN.

The index of the orthognathic functional treatment need (IOFTN) has been recently developed by Ireland et al. in the UK, aiming at prioritizing severe malocclusions not amenable to orthodontic treatment alone and need orthognathic surgery. IOFTN has 5 categories, from a Very Great Need (grade 5) through to No Need for treatment (grade 1) (Ireland *et al*., 2014).

The decision on whether starting an orthosurgical treatment depends on the negative esthetic, functional and social impact the dentofacial deformity and on the quality of life of each patient. Assessing the quality of life of these individuals by means of applying specific questionnaires before treatment onset can increase the success rate of orthosurgical treatment. These questionnaires assess not only the esthetic factor, but also the functional conditions that may be affected as well as the psychological issues related to self-esteem and sociability, all of which must be assessed in order to enable the development of an individual treatment plan that meets patient's expectations. The current objective of orthognathic treatment consists not only in treating the esthetic functional components of dentofacial deformities, but also in considering patient's psychological factor (Miguel *et al*., 2014).

The concept of quality of life was defined in 1993 by the World Health Organization as the perception of people with regard to their situation in life, within the cultural context and values with which they live, in relation to their objectives, expectations, patterns and concerns (Organization,

1993). Quality of life is essentially a subjective concept that cannot be judged by others. So, the Orthognathic Quality of Life Questionnaire (OQLQ) was developed and validated by (Cunningham *et al*., 2000) whose objective was to assess the impact of dentofacial deformities and the benefits of orthosurgical treatment on patient's quality of life. This Questionnaire has been widely used in researches.

This study is to evaluate and analyze the orthognathic functional treatment needs and quality of life in patients with dentofacial deformities. It can find out the severities of orthognathic functional treatment need and quality of life among patients with dentofacial deformities. It may also assist in prioritization of treatment needs in planning of public health service.

Materials and Methods

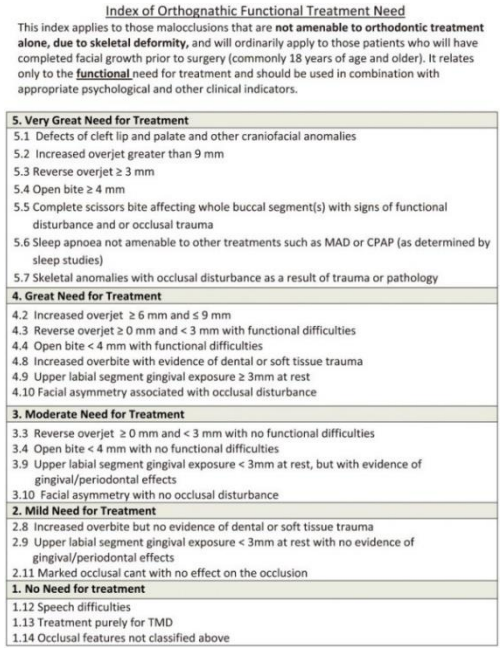
All patients seeking orthodontic treatment at the Department of Orthodontics and students from University of Dental Medicine, Yangon were screened by clinical assessment. Among them, patients and students with skeletal problems were selected according to the selection criteria. They were explained about the research and informed consents were obtained to those who were willing to participate in this study.

During the clinical assessment, history taking, extraoral and intraoral examination was done. Extraorally, skeletal problems on three planes were evaluated to determine skeletal pattern and skeletal problems for selection criteria. And upper labial segment, gingival exposure at rest, facial asymmetry and cant of occlusal plane were also measured. Interarch problems such as overjet, reverse overjet, open bite and overbite were measured intraorally to identify the grading for IOFTN. Both extra and intra-oral measurements were done with a metal ruler. Then, history of trauma or pathology, occlusal disturbances/occlusal trauma, functional difficulties, speech difficulties, temporomandibular joint dysfunction and sleep apnoea were examined for detailed description. The routine lateral cephalometric analysis by using routine lateral cephalogram of the patient to confirm the clinical data, skeletal problems and dentoskeletal problems were identified by using cephalometric norms.

The impressions of upper and lower jaws were taken by using perforated stock trays and alginate impression material, and then, poured with dental stone. The study models were taken to confirm overjet, reverse overjet, open bite, scissors bite. Dimensions were measured with digital slide clipper that could provide the precision reading to the nearest 0.01 mm. Then, photo records on front view, profile view, 45° view of patient on relaxed position extraorally and front view, profile views (right and left) on centric occlusion and upper and lower arch occlusal views were taken intraorally.

Then, subjects were asked to fill the orthognathic quality of life questionnaire (OQLQ) that had been translated into Myanmar version. The registration number was recorded on study model with indelible pencil. This number were duplicated and recorded on the questionnaire form and photo

record. The data were recorded for the final reading.

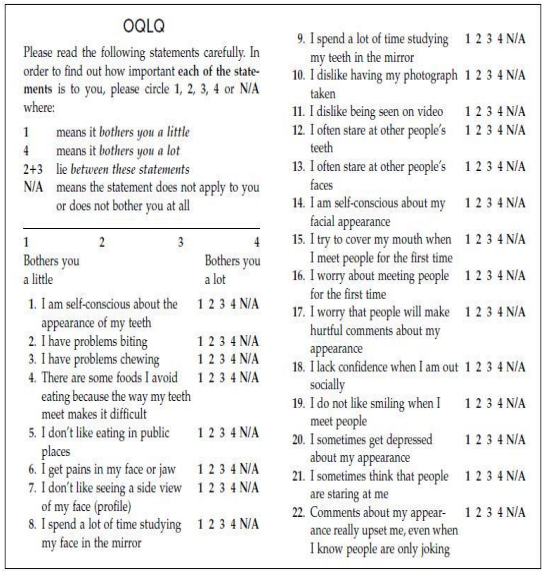


Index of Orthognathic Functional Treatment Need

This index applies to those malocclusions that are **not amenable to orthodontic treatment alone, due to skeletal deformity,** and will ordinarily apply to those patients who will have completed facial growth prior to surgery (commonly 18 years of age and older). It relates only to the **functional** need for treatment and should be used in combination with appropriate psychological and other clinical indicators.

5. Very Great Need for Treatment
5.1 Defects of cleft lip and palate and other craniofacial anomalies
5.2 Increased overjet greater than 9 mm
5.3 Reverse overjet ≥ 3 mm
5.4 Open bite ≥ 4 mm
5.5 Complete scissors bite affecting whole buccal segment(s) with signs of functional disturbance and or occlusal trauma
5.6 Sleep apnoea not amenable to other treatments such as MAD or CPAP (as determined by sleep studies)
5.7 Skeletal anomalies with occlusal disturbance as a result of trauma or pathology
4. Great Need for Treatment
4.2 Increased overjet ≥ 6 mm and ≤ 9 mm
4.3 Reverse overjet ≥ 0 mm and < 3 mm with functional difficulties
4.4 Open bite < 4 mm with functional difficulties
4.8 Increased overbite with evidence of dental or soft tissue trauma
4.9 Upper labial segment gingival exposure ≥ 3mm at rest
4.10 Facial asymmetry associated with occlusal disturbance
3. Moderate Need for Treatment
3.3 Reverse overjet ≥ 0 mm and < 3 mm with no functional difficulties
3.4 Open bite < 4 mm with no functional difficulties
3.9 Upper labial segment gingival exposure < 3mm at rest, but with evidence of gingival/periodontal effects
3.10 Facial asymmetry with no occlusal disturbance
2. Mild Need for Treatment
2.8 Increased overbite but no evidence of dental or soft tissue trauma
2.9 Upper labial segment gingival exposure < 3mm at rest with no evidence of gingival/periodontal effects
2.11 Marked occlusal cant with no effect on the occlusion
1. No Need for treatment
1.12 Speech difficulties
1.13 Treatment purely for TMD
1.14 Occlusal features not classified above

Figure 1. Index of Orthognathic Functional Treatment Need



OQLQ

Please read the following statements carefully. In order to find out how important **each of the statements** is to you, please circle 1, 2, 3, 4 or N/A where:

1 means it *bothers you a little*
4 means it *bothers you a lot*
2+3 lie *between these statements*
N/A means the statement does not apply to you or does not bother you at all

1 2 3 4
Bothers you a little — Bothers you a lot

1. I am self-conscious about the appearance of my teeth 1 2 3 4 N/A
2. I have problems biting 1 2 3 4 N/A
3. I have problems chewing 1 2 3 4 N/A
4. There are some foods I avoid eating because the way my teeth meet makes it difficult 1 2 3 4 N/A
5. I don't like eating in public places 1 2 3 4 N/A
6. I get pains in my face or jaw 1 2 3 4 N/A
7. I don't like seeing a side view of my face (profile) 1 2 3 4 N/A
8. I spend a lot of time studying my face in the mirror 1 2 3 4 N/A
9. I spend a lot of time studying my teeth in the mirror 1 2 3 4 N/A
10. I dislike having my photograph taken 1 2 3 4 N/A
11. I dislike being seen on video 1 2 3 4 N/A
12. I often stare at other people's teeth 1 2 3 4 N/A
13. I often stare at other people's faces 1 2 3 4 N/A
14. I am self-conscious about my facial appearance 1 2 3 4 N/A
15. I try to cover my mouth when I meet people for the first time 1 2 3 4 N/A
16. I worry about meeting people for the first time 1 2 3 4 N/A
17. I worry that people will make hurtful comments about my appearance 1 2 3 4 N/A
18. I lack confidence when I am out socially 1 2 3 4 N/A
19. I do not like smiling when I meet people 1 2 3 4 N/A
20. I sometimes get depressed about my appearance 1 2 3 4 N/A
21. I sometimes think that people are staring at me 1 2 3 4 N/A
22. Comments about my appearance really upset me, even when I know people are only joking 1 2 3 4 N/A

Figure 2. Orthognathic Quality of Life Questionnaire

Statistical analysis

After cleaning the collected data, analysis was done by using SPSS version 16. Frequency tables and graphs were used to describe categorical variables and mean and standard deviation were used to describe the continuous variables. The association between two categorical variables was assessed by using Chi-square statistic. *P* value <0.05 were set as statistical significant.

Results

Sixty orthodontic patients with skeletal deformities, who attended to Department of Orthodontics, were randomly selected. A cross-sectional analytical study design was used to identify the index of orthognathic functional treatment needs (IOFTN grading) and patients' quality of life (OQLQ scores). Chi-square test was used to find out the association between orthognathic functional treatment needs and quality of life in patients with dentofacial deformities.

Table 1. Frequency distribution of reasons for seeking orthodontic treatment among study population

Reason	Frequency	Percentage
Aesthetic	56	93.3
Functional	4	6.7
Total	60	100.0

On determining the reason for seeking orthodontic treatment among 60 subjects, 56 subjects (93.3%) were for esthetic reason and only 4 subjects (6.7%) were for functional reason.

Table 2. Frequency distribution of presence of functional problems among study population

Functional Problems	Frequency	Percentage
Yes	30	50.0
No	30	50.0

On determination of functional problems among study population, half of the subjects had functional problems (50%).

Table 3. Frequency distribution of IOFTN grading among study population

IOFTN grading	Frequency	Percentage
Grade 1	3	5.0
Grade 2	1	1.7
Grade 3	8	13.3
Grade 4	13	21.7
Grade 5	35	58.3
Total	60	100.0

On determination of IOFTN grading among study population, grade 1 was (5%), grade 2 (1.7%), grade 3 (13.3%), grade 4 (21.7%) and grade 5 (58.3%) respectively. The most prevalence was grade 5 (58.3%). The combination of grade 4 and grade 5 among all grades was (80%)

Table 4. Frequency distribution of IOFTN scores among study population

IOFTN scores	Frequency	Percentage
1.13	2	3.3
1.14	1	1.7
2.8	1	1.7
3.3	6	10.0
3.10	2	3.3
4.2	7	11.7
4.3	2	3.3
4.4	3	5.0
4.10	1	1.7
5.1	7	11.7
5.2	7	11.7
5.3	19	31.6
5.4	2	3.3
Total	60	100.0

On determination of IOFTN scores among study population, 1.13 was (3.3%), 1.14 (1.7%), 2.8 (1.7%), 3.3 (10%), 3.10 (3.3%), 4.2 (11.7%), 4.3 (3.3%), 4.4 (5%), 4.10 (1.7%), 5.1 (11.7%), 5.2 (11.7%), 5.3 (31.6%) and 5.4 (3.3%) respectively**.** The most prevalent IOFTN score was 5.3(31.6%).

Table 5. OQLQ distribution among study population

OQLQ	Mean ± SD	Min-Max	Possible Variation
Social aspects	9.35 ± 8.25	0 – 29	0-32
Facial aesthetics	10.70 ± 4.62	2 – 20	0-20
Oral function	3.50 ± 3.96	0 – 15	0-20
Awarenes of dentofacial esthetics	5.01 ± 3.78	0 – 15	0-16
Total	28.55 ± 16.26	2 – 79	0-88

On determination of OQLQ distribution among study population, the value of mean standard deviation for social aspect was 9.35±8.25 (0-29), facial esthetics 10.70±4.62 (2-20), oral function 3.50 ± 3.96(0-15), and awareness of dentofacial esthetics 5.01 ± 3.78(0-15) respectively. According to the mean value, facial esthetics domain had largest score among four domains.

Table 6. Association between IOFTN grading and four domains of OQLQ among study population

Domains	Grade ≤ 3	Grade 4	Grade 5	*p*
Social aspect	6.6 ± 5.4	8.3 ± 8.1	10.6 ± 8.9	0.31
Facial aesthetics	11.0 ± 2.5	9.2 ± 3.3	11.1 ± 5.4	0.43
Oral function	1.9 ± 2.4	4.0 ± 4.4	3.8 ± 4.1	0.30
Awareness of dentofacial esthetics	4.5 ± 3.2	3.2 ± 2.4	5.8 ± 4.1	0.09
Total	24.1± 10.2	24.6 ± 14.0	31.4 ± 18.2	0.25

The *p*-value for social aspect was (0.313), facial esthetics (*p* value-0.438), oral function (*p* value-0.305), and awareness of dentofacial esthetics (*p* value-0.096). All grades had the largest mean standard deviation values in facial esthetics domain. The mean standard deviation values of oral function domain in all grades were the least scores compared with those of other domains. Grade 5 had the largest total mean score among the other grades. Total p-value for four domains was 0.258. So, there was no significant association between IOFTN grading and four domains of OQLQ.

Table 7. Association between IOFTN grading and quality of life among study population

IOFTN graing		Quality of Life	
		Good (<28.5)	Poor (>28.5)
Grade 1, 2, 3	Count (%)	7 (58.3)	5 (41.7)
Grade 4	Count (%)	9 (69.2)	4 (30.8)
Grade 5	Count (%)	17 (48.6)	18 (51.4)
Total	Count (%)	33 (55.0)	27 (45.0)

p value = 0.427, Chi-square test

In grade 5 (very great functional treatment need), 51.4%had poor quality of life. Totally, 55.0% of the study population had good quality of life. The Chi-square test value for association between IOFTN grading and quality of life among study population was 1.702 and *p*-value of 0.427. Therefore, there was no statistically significant association between IOFTN and quality of life.

Table 8. Association between age and OQLQ score among study population

OQLQ	≤ 25	> 25	*P*
Social aspect	10.0 ± 8.8	7.4 ± 6.5	0.27
Facial aesthetics	10.6 ± 4.4	10.8 ± 5.1	0.89
Oral function	2.8 ± 2.9	5.1 ± 5.5	0.04*
Awareness	5.3 ± 3.6	4.1 ± 4.0	0.28
Total	28.9 ± 16.2	27.5 ± 16.7	0.76

*Significant, Chi-square test

The *p*-value for social aspect domain was (0.271), *p*-value (0.898) in dentofacial esthetics domain, *p*-value (0.046) in oral function domain and *p*-value (0.283) in awareness domain, respectively. In social aspect domain, the standard deviation value in ≤ 25 years age group (10.0 ± 8.8) was greater than those in >25 years age group(7.4 ± 6.5). The standard deviation values were nearly the same in dentofacial esthetics domain and awareness domain when comparing two age groups. But there were found that no statistically significant association in age and social aspect domain, age and dentofacial esthetics domain, age and awareness domain. But there was statistically significant association between age and oral function domain of OQLQ (*p*-value - 0.046). The value of mean standard deviation for oral function domain in > 25 years age group was (5.1 ± 5.5) and was greater than those in ≤ 25years age group (2.8 ± 2.9).

Table 9. Association between gender and OQLQ score among study population

OQLQ	Male	Female	*P*
Social aspect	10.7 ± 8.5	8.1 ± 7.9	0.22
Dentofacial aesthetics	11.8 ± 5.0	9.7 ± 4.0	0.07*
Oral function	3.7 ± 3.7	3.3 ± 4.1	0.67
Awareness	6.4 ± 3.9	3.8 ± 3.2	0.00*
Total	32.8± 15.5	25.0 ± 16.2	0.06*

*Significant, Chi-square test

The *p*-value for social aspect domain was 0.228, *p*-value (0.071) in dentofacial esthetics domain, *p*-value (0.674) in oral function domain and *p*-value (0.006) in awareness domain, respectively. According to the mean standard deviation values, male group had greater scores than female group in all domains. But there were no statistically significant association between gender and social aspect, dentofacial esthetics, oral function domains. But there was a statistically significant association between gender and awareness domain of OQLQ (p-value -0.006). The value of mean standard deviation for awareness domain in males was (6.4±3.9) and was greater than those in female (3.8±3.2).

Discussion

On determining the reasons for seeking orthodontic treatment among study population in this study, most of the patients were for esthetic reason (93.3%) and only 6.7% were for functional reason. One of the studies has shown that aesthetics was the most prevalent chief complaint among patients seeking for combined orthodontic-orthognathic treatment

(Lee *et al*., 2014). That study was consistent with the current study.

Over the years, studies have demonstrated that most patients with dentofacial deformities seeked treatment in order to have their facial and dental esthetics improved. Additionally, some studies reported that the main motivation comprised improvements in masticatory function rather than changes in appearance (Choi *et al*., 2010; Miguel *et al.*, 2014). Our sample of 60 subjects with skeletal discrepancies were interviewed during clinical assessment, half of the patients had functional problems associated with dentofacial problem.

When application of IOFTN on my study population, no need treatment (grade 1) was (5%), mild need treatment (grade 2) was (1.7%), moderate need treatment (grade 3) was (13.3%), great need treatment (grade 4) was (21.7%) and very great treatment need (grade5) was (58.3%) respectively. The most prevalence was grade 5. The combination of grade 4 and grade 5 was 80% among study population. These results were consistent with orther studies using IOFTN, indicating that most of their studies population were scored in the top two categories (James *et al*., 2015; Harrington *et al*., 2015; Borzabadi Farahani *et al*., 2016).

Most of our patients 80% fell into great need (grade 4) and very great need (grade 5) and can be considered greatest need for orthognathic treatment. According to the prevalence of sub-categories of IOFTN, the most prevalence score in our sample was 5.3(31.6%), followed by 5.1, 5.2 and 4.2 (11.7%), 3.3 (10%), 4.4(5.0%), 5.4, 4.3, and 1.13 (3.3%) and 4.10, 2.8, and 1.14 (1.7%) serially. IOFTN is based on purely functional indicators rather than aesthetic components, although psychological and other factors should be considered when making a decision on eligibility for treatment (Jame *et al*., 2015). In this study, subcategory 5.1 (the defects of cleft lip and palate and other craniofacial anomalies) was found in 11.7% of study population. For my study, the quality-of-life scores measured through OQLQ (Myanmar version). This study revealed that facial esthetics domain had largest score among four domains (10.70 ± 4.62) and was the most commom. Social aspect was the second most (9.35±8.25), awareness of dentofacial esthetics was third (5.01±3.78), fourth was oral functional domain (3.50±3.96). It is inconsistent with one of the studies in which the social aspect domain was shown to be more important for patients than were facial esthetics and oral function (Abdullash, 2015). According to OQLQ scores, 27 patients expressed poor quality of life and 33 patients had good quality of life. Cunningham *et al* reported greater mean scores in the OQLQ for the presurgery subjects (Cunningham *et al*., 2002).

For my study, the quality-of-life scores measured through OQLQ (Myanmar version). This study revealed that facial esthetics domain had largest score among four domains (10.70 ± 4.62) and was the most commom. Social aspect was the second most (9.35±8.25), awareness of dentofacial esthetics was third (5.01±3.78), fourth was oral functional domain (3.50±3.96). It is inconsistent with one of the studies in which the social aspect domain was shown to be

more important for patients than were facial esthetics and oral function (Abdullash, 2015).

There was no significant association between age group and QoL among study population in the current study (*p*-value-0.763). In a study, the correlation analysis of age of the patients with dentofacial deformity produced impacts over QOL by using OQLQ showed that the older the patients, the greater the negative impact over quality of life mainly in facial aesthetics and oral function domains (Bortoluzzi *et al*., 2015). It was consistent with this study. In the current study, there were no significant associations between age and social aspect, dentofacial esthetics, awareness domains. But there was a significant association between age and oral function domain (*p*-value-0.046). Over 25-year age group had the higher score in oral function than 18-25 years age group. The scores in social aspect domain of OQLQ was high in 18-25 years age group and described as this group have more social impact concerning with their deformities than over 25 years age group.

There was no significant association between gender and QoL among study population in this study. But more than half of the male population 55.6% has poor quality. It was inconsistent with other studies (Stagles *et al*., 2015; Bortoluzzi *et al*., 2015). They found that the impact of dentofacial deformity was more pronounced in female in the social and awareness domains of the OQLQ in their studies. In current study, there was a significant association between gender and awareness domain (*p*-value-0.006). The mean value of standard deviation for awareness domain in males (6.4±3.9) was greater than those in female (3.8±3.2). Male patients were more aware their dentofacial esthetics and severe dentofacial deformity.

Therefore, the evaluation of treatment priority for dentofacial deformity based on index of orthognathic functional treatment needs alone could not be sufficient enough for deciding treatment need and quality of life should be encountered to achieve good decision for treatment priority for the presurgery subjects (Cunningham *et al*., 2002).

Conclusion

In this study, 80% of the study population was included in the great need and very great need for treatment according to IOFTN. The most prevalent subcategory was 5.3 (31.6%) with reversed overjet ≥ 3mm. There was a significant association between gender (male) and awareness of facial aesthetic domain of OQLQ. Over 25 years age group had the higher score in oral function. 18-25 years age group had more social impact concerning with their deformities. There was no statistically significant association between severity of malocclusion and treatment need according to IOFTN and quality of life. Further study should be done on patients who undergone the orthognathic surgical treatment to evaluate the quality of life between pre and post treatment.

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The authors declare there is no potential conflict of interest.

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Costochondral graft in the treatment of Temporomandibular joint ankylosis: Case Report

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***Abstract* – Temporomandibular joint ankylosis is one of the most disruptive anomalies that affects the masticatory system. As there are several biologic and anatomic similarities to the mandibular condyles, autogenous costochondral grafts have been considered to be the most acceptable tissue for temporomandibular joint reconstruction in young individuals. Donor site complications are infrequent, and regeneration of the rib usually occurs within a year post operatively in children. This study indicated that using costochondral grafts to reconstruct temporo-mandibular joint ankylosis in children provides a good result.**

Key words:* *temporomandibular joint ankylosis, temporomandibular joint reconstruction, costochondral graft

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Introduction

Temporomandibular joint ankylosis is the bony or fibrotic fusion between anatomic components of the temporomandibular joint with symptoms of pain on chewing, speaking difficulty, lip incompetence. As the condyle is considered a primary mandibular growth centre, ankylosis causes interference with the development of the bone, and asymmetry will increase progressively until maturity is reached. In bilateral ankylosis, ‘‘bird-face’’ appearance may result. The most common causes of temporomandibular joint ankylosis are trauma and local or systemic infection such as otitis media, pre-auricular abscess, poliomyelitis, tuberculosis ankylosing spondylitis, rheumatoid arthritis and psoriasis (Tehranchi *et al.*, 2016).

Temporomandibular joint ankylosis may be classified according to the site (intra or extra-articular), type of tissue involved (bony, fibrous or fibroosseous tissue) and the degree of fusion (complete or incomplete) (Rowe, 1982). Treatment options of temporomandibular joint ankylosis are gap arthroplasty, interposition arthroplasty using temporal muscle fascia, ear cartilage or alloplastic material and reconstruction of the temporomandibular joint using costochondral graft, fibula, clavicle, iliac crest, metatarsal head or alloplastic material like acrylic or titanium prosthesis. Gap arthroplasty which is preformed without intervention grafts or materials and is based on resection of ankylosed bone. A minimum of 15 mm gap is recommended between the recontoured glenoid fossa and the mandible for preventing reankylosis. In interpositional arthroplasty technique, autogenous and alloplastic

materials are placed in the osteotomized area to prevent recurrence of ankylosis. The goals of treatment for temporomandibular joint ankylosis are increasing the range of mouth opening and improving mandibular function, decreasing disability and pain, preventing reankylosis and allowing for possible growth of the jaw in young patients. In adult, the main objective of condylar reconstruction is to restore lost function and symmetry of the temporomandibular joint. In children, there is an additional objective of using a graft that has an adequate growth potential. Temporomandibular joint reconstruction is a suitable option for young patients with limited ramus length who need further condylar growth. The preferred choice in children is costochondral graft. The use of autogenous costochondral graft for TMJ ankylosis was first described by Gillies in the 1920. Poswillo in 1974 demonstrated the functional similarities, both histologic and physiologic between mandibular condyle and rib cartilage. The bony part of the rib is used to replace the condylar neck, while the cartilaginous portion rests in the existing or newly constructed glenoid fossa. The bone and cartilage junction provides a center with growth potential (Saeed and Kent, 2003).

The advantages of costochondral graft are low mobility rate at the donor site, regeneration of the rib usually occurs within a year postoperatively in children. Clinically the graft provides the mandible with an active growth centre in children while in adults it prevents jaw deviation or production of an open bite in bilateral cases. It has almost similar primary and secondary cartilage to those of the mandibular condyle and therefore it was thought that its growth potential is similar to that of the condyle. It acts as an adaptive centre to promote symmetrical growth of the mandible and function as well as correction of mandibular retrognathia and latero-gnathia which overall improves the psychological outlook for both the patient and parent. The disadvantages of this method are possible donor site complications: pleural tear, pneumo-thorax, pleural effusion, empyema, poor quality and flexibility of bone, which is prone to fracture, possibility of infection and the most importantly unpredictability of growth, inability of the graft to adapt to the growth velocity of the new environment. Late complications at the donor site include chronic pain, scarring, chest wall instability, and breast deformity. Chest deformities can be decreased considerably by preserving even a minimal rim of the upper margin of the sixth rib cartilage to obtain the basic ear shape of the framework. The lack of predictability of growth pattern of the costochondral graft is considered to be on of the main disadvantages of the technique.

Many considered costochondral graft as a secondary growth site, which adapts to overall transitional movements of the mandible.

In contrast, some believe that costochondral graft has the potential to grow independently as a primary growth center. This unpredictable growth pattern might end up in progressive deviation towards the contralateral side of the ankylosis, following postoperative overgrowth of

costochondral graft (Lou and Dong, 2000). Hence, the linear changes of the graft site after surgery cannot be certain. In most children, the grafted side grows more than the unaffected side until the two sides become equal and afterwards, the two condyles grow at the same rate; however, overgrowth of the costochondral graft may occur in some cases (Khadka and Hu, 2012).

Case report

Four years old girl, came to the Department of Oral and Maxillofacial Surgery, University of Dental Medicine, Yangon with the chief complaint of limitation of mouth opening for 2 years, who has history of abscess at right side of the mandible due to dental infection and hospitalized and drained abscess in 2 years ago. After that, the patient experienced gradually decreased in mouth opening associated with difficulty in eating and speaking. On examination, facial asymmetry and chin deviation to right side was observed (Figure 1,2,3). The patient was planned for surgery (gap arthroplasty by condylectomy and reconstruction with autogenous costochondral graft) under general anaesthesia with fibre optic video laryngoscope guided intubation.

Under general anaesthesia, exposure of the temporomandibular joint was done by a combined preauricular and retromandibular approach (Figure 4a, 4b) to assess mandibular condyle, coronoid process and ascending ramus. The site of the ankylosis was identified and the fibrous and bony mass were excised which leaving a gap of approximately 20 mm between the ascending ramus and the glenoid fossa. Articular disc was left intact (Figure 5). Mandibular movement and mouth opening were checked (Figure 6). Temporary maxilla-mandibular fixation was done (Figure 7). Costochondral graft was harvested after the gap arthroplasty. The ribs were counted and marked with a marking pen. The outline of a 6-8 cm line was drawn at 6^{th} or 7^{th} rib region which would be the future location of the inframammary crease (Figure 8). 10 mm of the cartilaginous cap was left to attach the medial aspect of the harvested rib in order to serve as a growth centre and to function against the native disc or glenoid fossa (Figure 9). The cartilaginous cap was reshaped (Figure 10) to mimic a condylar head and to seat ideally within the articular disc and glenoid fossa and 5 mm of cartilage was preserved at the rib-cartilage junction (Figure 10) and suturing at donor site was done (Figure 11). The graft was inserted through the retromandibular incision. The costochondral graft fit passively along the lateral surface of the ascending ramus while cartilaginous cap was seated within the articular disc and glenoid fossa (Figure 12). The costochondral graft was fixed to the lateral surface of ascending ramus with plate and screws (Figure 13). Mandibular movement, mouth opening, and occlusion were rechecked. Mouth opening after costochondral graft fixation was 35 mm and then closure of the wound was done (Figure 14).

Figure 1. Preoperative photo of temporomandibular joint ankylosis

Figure 2. OPG showing temporoman - dibular joint ankylosis right side with deformity

Figure 3. CBCT showing temporo-mandibular joint ankylosis right side

Figure 4 (a). Incision marking for exposure of the temporomandibular joint

Figure 4 (b). Exposure of the temporomandibular joint

Figure 5. Excision of bony mass

Figure 6. Intraoperative mouth opening

Figure 7. Temporary maxilla-mandibular fixation

Figure 8. Exposure of 6th and 7th rib region

Figure 9. A portion of cartilagenous cap was left attached

Figure 10. The reshaped costal cartilage

Figure 11. Suturing at donor site

Figure 12. The graft was inserted through the retromandibular incision and fixed with plate and screw

Figure 13. The graft was fixed with plate and screw

Figure 14. Closure of wound

Figure 15. Post operative one week photo

Figure 16. Post operative one-week OPG Xray

Figure 17. Post operative 18 months photo

Figure 18. Post operative 18 months OPG Xray

Discussion

The high recurrence rate and the technical difficulties involved in the temporomandibular joint surgery make a challenging for the surgeon. Numerous protocols for management of temporomandibular joint ankylosis throughout the world suggest early surgical intervention, elaborate resection, early mobilization and aggressive physiotherapy for at least 6 months postoperatively.

One of the surgical procedures is a gap arthroplasty without inter-positioning which increase risk of reankylosis. Hence, a gap arthroplasty with interpositioning is preferable. The main function of an inter-positional material is to eliminate contact between two bony surfaces of the joint and avoid reankylosis. The most commonly used interpositional material is costochondral graft.

The disadvantages of costochondral graft are possible donor site complications and unpre-dictability of growth pattern. In this case report, the result of using costochondral grafts provides a good result up to now (Figure 15,16,17 and 18).

There are numerous surgical protocols which included ankylotic mass resection, ipsilateral coronoidectomy, contralateral coronoidectomy, interposition, early mobilization with aggressive physiotherapy. In this case report, the mouth opening was achieved 35 mm after gap arthroplasty. So condylectomy alone was enough and no need for ipsilateral or contra lateral coronoidectomy.

In some literatures, the intermaxillary fixation for 2 to 6 weeks depends on stability of graft and then aggressive mouth-opening exercising begins. In this case report, post operative intermaxillary fixation was not used because of young age. The patient was allowed oral feeding since immediately recovery from general anaesthesia. This daily usual oral feeding got mouth opening exercise. Mouth opening, mandibular growth, occlusion and re-ankylosis were checked during regular follow up visit.

Administration of general anaesthesia is a major problem in temporomandibular joint ankylosis patient due to limited mouth opening. So, blind nasal intubation or tracheostomy was used in the past. Nowadays, fiberoptic video laryngoscope guided intubation technique is well established. The patient was successfully intubated by using fiberoptic video laryngoscope which can avoid blind nasal intubation. It is very difficult to obtain from younger group of patients, bleeding due to local trauma, secretions in the airway and distorted tissue anatomy which made it even more difficult especially in children.

Conclusion

TMJ reconstruction has been one of the greatest challenges to surgeons over decades. There is no single standard treatment protocol for temporo-mandibular joint ankylosis. The failure rate still remains high. Postoperative phase of physiotherapy and regular follow up along with patient's motivation and education is necessary for obtaining good result and for avoiding reankylosis. Patients with possible trauma to temporomandibular joint and infection should be carefully evaluated. Unnoticed dental infection can cause potential complications concerning with the temporo-mandibular ankylosis even after several years similar to the reported cases. Early treatment will restore mandibular mobility and subsequently improve facial growth and remodeling to reduce the possibility of the future facial asymmetry. To improve the patient's quality of life, the distraction osteogenesis, the orthodontic treatment and the orthognathic surgery should be considered as a comprehensive management.

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One of the ways improving social integrity: Ocular Prosthesis: Case Report

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***Abstract* - The eye is a vital organ and an important part of facial expression. The loss of one or both eyes cause social, psychological and physical distress to the patient. The ocular prosthetic rehabilitation is associated to psychosocial improvement, once the prostheses are able to influence positively interpersonal relations, which lead to a positive impact on the quality of life. There are various materials and techniques used for the fabrication of the ocular prosthesis. This article presents a case treated with custom made ocular acrylic prosthesis which has restored functional and esthetic results with optimal retention.**

Keywords*: *ocular prostheses, acrylic, evisceration, facial esthetic, retention

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Introduction

The art of making artificial eyes has been practiced since ancient times. Egyptian priests made the first ocular prosthesis, called Ectblepharons, as early as the 5th century BC. In those days, artificial eyes were made of enameled metal or painted clay and attached to cloth and worn outside the socket. The first in-socket artificial eye made in the 15th century was made of gold with coloured enamel. In the latter part of the 16th century, the Venetian glass artisans discovered a formula that could be tolerated inside the eye socket. These early glass eyes were crude, uncomfortable to wear and very fragile (Somkuwar *et al*., 2009). In 1944, by the combined efforts of the individuals of the armed forces of the United States, methyl-methacrylate resin was successfully used for the fabrication of the ocular prosthesis (Nagaraj *et al*., 2015). Today many patients all around the world wear ocular prosthesis made of acrylic (Somkuwar *et al*., 2009). Since then, usage of resin gained popularity because of its light weight, translucency, better fracture resistance, ease of fabrication, easy adjustability, and its capability for intrinsic and extrinsic coloring (Nagaraj *et al*., 2015).

Eyes are generally the first feature of the face to be noticed. An unfortunate absence or loss of an eye may be caused by a congenital defect, irreparable trauma, a painful blind eye, sympathetic opthalmia or the need for histologic confirmation of a suspected diagnosis (Kumar Ch. & Sajjan, 2010). Loss of eye has crippling effect on the psychology of the patient. The ocular prostheses help to rehabilitate the patient in the society with normal appearance and self-esteem (Takshil *et al.*, 2017). Two surgical procedures are generally used, one is evisceration, which is the removal of the contents of the globe, leaving the sclera and on occasions the cornea in place, and the

other procedure is enucleation where the eyeball is completely removed (Kumar Ch. & Sajjan, 2010).

Case report

A 36-year-old male reported to the Department of Prosthodontics, University of Dental Medicine (Yangon) with chief complaint of missing right eye. He gave a history of infection to the right eye. Based on the clinical findings and history, the case was diagnosed as eviscerated right eye and ocular implant (a hard, rounded device surgically and permanently embedded in the eye socket) was placed in the eye socket to replace some of the volume lost during operation.

On examination of the defective eye socket, it was found that a conformer was placed by eye surgeon some weeks after surgical eye removal. This maintains shape of eye lid and acts as placeholder for the prosthetic eye. Examination after removal of a conformer was done, intraocular tissue bed was healthy and with adequate depth between the upper and lower fornices for retention of the ocular prosthesis.

Patient was explained about the treatment procedure.

Figure 1. Photograph showing conformer with ocular defect of the patient

Procedures

1. Fabrication of stock tray: size of human adult eye is approximately one inch in diameter. So, eye contour tray with handle was made by using modeling wax then packing with heat cure acrylic resin. Making retentive holes, polishing and trimming were done.

Figure 2. Photograph showing stock tray fabricated to make impression

2. Ocular impression: The patient's eye socket was coated with a thin layer of Vaseline and an impression was made using medium body addition silicone impression material. Impression was made by injecting the material first into the depth below the upper eye lid and then into the lower. This was done so as to record the proper extensions of the defect. After that the whole eye socket was filled with material and the patient was asked to close his eye, the excess material could flow out. Patient was asked to move his eye to the right and to the left, then up and down and finally in a circular motion, so that the functional impression of the defect could be obtained. The impression was retrieved when it had completely set.

Figure 3. Photographs showing impression making (a) and ocular impression of tissue bed (b)

3. Fabrication of wax pattern: This impression was then invested to obtain a sectional cast. The first half of sectional cast was poured while keeping the impression surface was immersed and after which the indexing of the first pour was done so as to allow orientation of the second half. After complete setting, the two halves of the cast were separated, and the impression was removed. Molten wax was filled through the hole made by the handle of impression tray. When the wax had set the cast was separated and the wax pattern was retrieved and carved. Wax pattern was smoothened to remove any sharp ridges or undesirable irregularities, properly contoured and then polished.

Figure 4. Photograph showing fabricated wax pattern

4. Wax pattern trial: First, the fullness of both palpebrae and the eye socket was checked along with the extensions, this was confirmed by asking the patient to close his eyes and patient was inspected from the profile view. During try in, the iris was placed keeping in mind the symmetry with the iris of the unaffected left natural eye of the

patient. To achieve this exact location, a micro tape was secured on the forehead and the midline of face was marked along with the position of the natural iris while he was looking straight ahead to a distant object. The measurements were engraved into the wax pattern. The pattern was taken out, the iris was placed and adjusted according to the horizontal and vertical axis. Also, his eye movements were checked for symmetry and function, and it was found that the wax eye try in moved and synchronized in harmony with the patient's natural eye movements. This gave a realistic feeling and instilled confidence in the patient.

Figure 5. Photograph showing wax pattern trial and iris placement

5. Fabrication of acrylic work: The trial wax pattern was invested, dewaxed, and packed with heat-cured clear acrylic resin and curing was carried out. After the flask was cooled, deflasking was done, prosthesis was separated from the investment, it was finished and polished. The polished prosthesis must be free of roughness that could irritate the eye socket and encourage secretions to accumulate for additional irritation.

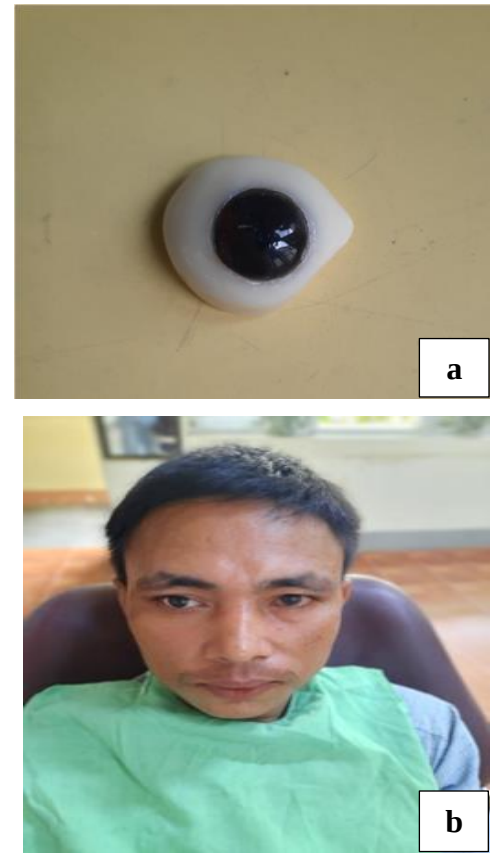

Figure 6. Photographs showing ocular prosthesis after acrylization (a) and initial placement of ocular prosthesis for adjustment (b)

6. Insertion and Instructions: Prosthesis was inserted and checked for fit, contour, and movements. Patient was demonstrated about proper insertion and removal the prosthesis. Necessary post insertion instructions were given to

the patients. Reappoint the patient to be seen 4 days later.

7. Second stage curing: During recall, fit, mobility and direction of gaze of the prosthesis were assessed. Disinfection with sodium hypochlorite was performed. Simulation of blood vessels with cotton wool was made. Thin layer of heat-cured clear acrylic was spread evenly around outer surface of prosthesis. Second stage curing was done and curing cycle was repeated.

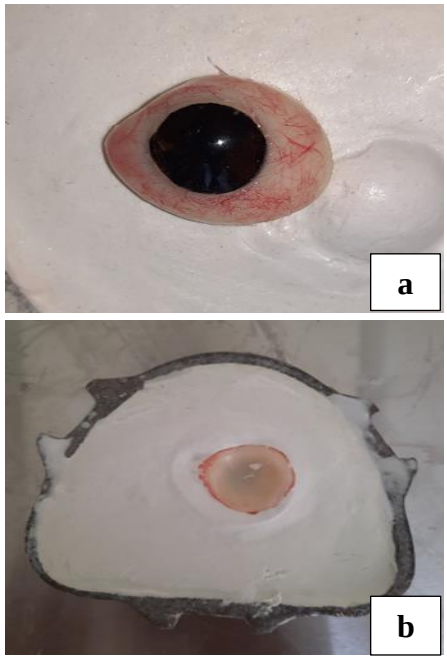

Figure 7. Photographs showing simulation of blood vessels (a) and second stage curing (b)

8. Final finishing and polishing of the prosthesis: Finished prosthesis requires a highly polished surface which would have a glass like finish to provide maximum adaptation and overall success of the prosthesis.

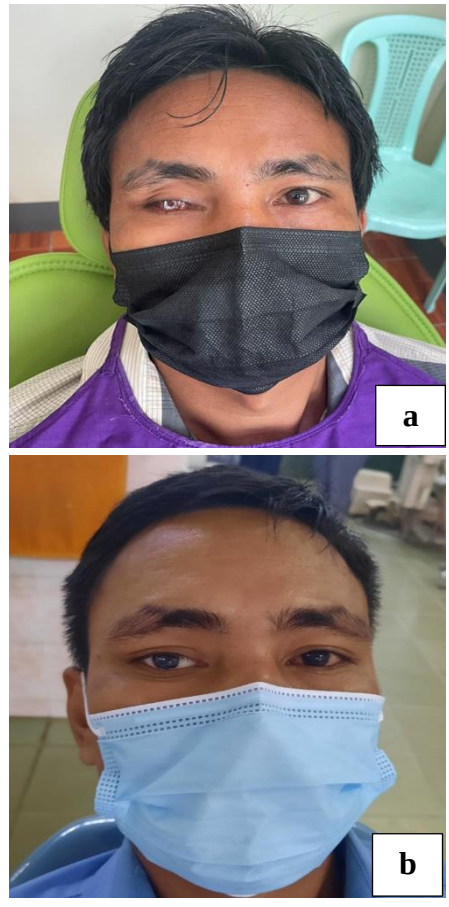

Figure 8. Photographs showing before ocular prosthesis delivery (a) and after prosthesis delivery (b)

9. The patient was given instruction for wearing the prosthesis and home care protocol is given below:
   - Prosthesis should be handled with care and with clean hands. Removal of acrylic prosthesis at night should be done.
   - Once removed from the eye socket, it should be placed in an antibacterial solution or contact lens soaking solution to kill the surface bacteria.

- It should never be allowed to dry otherwise it causes various layers to separate.
- It also needs to be cleaned annually and should be replaced every 5-7 years.
- Routine polishing of prosthesis should be done every year to prevent deposition of protein and bacteria.

Discussion

Every human being is created with a pair of eyes which serves as sense organs of sight and adds to the beauty of the face. It also performs various other functions including a very important role in nonverbal communication. Patient is satisfied with the outcome of prosthesis. Because the ocular prosthesis can move as the muscles move in their normal course resulting in a more realistic. Prosthesis is also light weighted, and he feels comfortable.

This report describes a case treated for the evisceration right eye with custom made ocular acrylic prostheses which has restored functional and esthetic results with optimal retention.

Conclusion

Success of the ocular prosthesis largely depends on the precise laboratory technique and artistic skills of the operator. A well-made and properly planned ocular prosthesis maintains its orientation when patient performs various movements. Although the patients cannot see with this prosthesis, it has definitely restored their self-esteem and allowed them to confidently face the world.

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Digital Guided Implant Surgery in Multiple Implant Placement: A Case Report

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Abstract - **The dental implant has become a widely accepted treatment modality in dentistry to rehabilitate patients with single, multiple, or complete edentulous sites. To achieve successful prosthetic outcomes, proper angulation and positioning of implants are essential. Use of surgical guide is the primary determinant associated with implant accuracy in accordance with speedy development of digital dentistry. Implant surgical guide facilitates proper positioning and angulation of implants using cone beam computed tomography (CBCT) and standard tessellation language (STL) data obtained from intraoral scanning. This case report messages to practitioners that guided digital implant surgical protocol provides many benefits for multiple implant placement.**

Keywords; guided implant surgery, multiple implants, digital surgical guide, intraoral scanning

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Introduction

Digital dentistry can be defined in a broad scope as any dental technology or device that incorporates digital or computer-controlled components in contrast to that of mechanical or electrical alone. This broad definition can range from the most common area of digital dentistry; CAD/CAM (Computer-Aided Design/ Computer-Aided Manufacturing) to computer-aided surgery especially digital guided implant dentistry which include design and fabrication of surgical guides (Smitkarn, 2019).

With an ever-increasing public awareness of the benefits of dental implantology, the popularity of dental implant rehabilitation will continue to increase in the future. Consequently, implant treatments are increasingly involved in general dental practice (Resnik, 2020).

Successful dental implant placement depends not only on osseointegration, but also on the function and esthetics of the final prosthesis (Margonar 2012, Motta 2016). Implant placement taking into consideration the appropriate angulation and position in relation to the adjacent teeth and underlying bone, or “prosthetically driven placement”, is quickly gainiping popularity.

Digital guided implant surgery is a technique in which digital imaging is combined with CAD/CAM software

and equipment to plan the most accurate approach to implant surgery. This method enables the clinician to select the most appropriate implants for a case, based on the patient's anatomy and dimensions of their soft-tissue, available bone, and arch. Implant surgical guide facilitates proper positioning and angulation of implants using cone beam computed tomography (CBCT) and assists in treatment planning (Fortin, 2006). Moreover, guided implant surgery also provides exact positions and parallel inclinations between implants than freehand surgery especially in multiple implant placement.

Although traditional plaster model-based implant surgical guides have been produced for a long time, recent imaging techniques, such as CBCT, provide a three dimensional (3D) evaluation of various anatomical structures, such as residual bone and nerves, before implant surgery. Moreover, with the recent introduction of CBCT, it is possible to obtain high-quality images with reduced radiation exposure to patients. CBCT enables a 3D reconstruction of the patient's oral cavity. The integration of intraoral scanners (IOSs) with computer-aided design and computer-aided manufacturing (CAD/CAM) technologies has enabled a fully digital workflow for dental restorative treatment (Revilla, 2018). With the development of CAD/CAM technology, combined use of scanning data obtained by intraoral scanning and CBCT images provide more accurate digital guide for implant surgery. 3D printing digital data allow clinicians to perform 3D implant simulations and fabricate digital surgical guides for clinical practice.

A surgical guide is fabricated and worn by the patient during surgery. Small sleeves are inserted into the surgical guide to direct the drill so the implant can be placed precisely. Guided surgery solutions offer clinicians the predictability and confidence of optimal implant positioning. Implant dentistry has shifted from a "surgically driven approach" to a "prosthetically driven approach", because appropriate implant positioning is crucial to achieving long-term functional and esthetic success. Digital technology is now commonly recommended because it can reduce inaccuracy in terms of implant positioning (Lin, 2020).

Proper angulation and positioning of dental implants are essential to achieve acceptable prosthetic outcomes especially in multiple implant placement. Poor angulation and positioning of the implant are associated with increased risk of complications, such as perforation of the lingual plate or inferior alveolar canal. The prosthesis can also be compromised causing unfavorable occlusal forces to be transmitted to the implants or poor aesthetics of the prosthesis (Rosenfeld 2006, Choi 2017). In addition, anatomical concerns, such as the impact of the implant-natural teeth or interimplant distance on crestal bone height and papilla contour rely on accurate planning and placement (Tarnow, 2000).

Therefore, it is critical to strategically place the implant fixtures. The challenge is that all surgical sites are different. Improving implant

accuracy has been the subject of substantial interest. Accumulating evidence suggests the use of a surgical guide is the primary determinant associated with implant accuracy in accordance with speedy development of the digital dentistry (Kramer 2005, Choi 2017). Several methods for surgical guidance have been proven effective in increasing accuracy. Given appropriate presurgical planning, including 3-dimensional radiographic imaging and proper case selection, 3D guided implant surgery may be an acceptable alternative. Therefore, it is critical to identify the accuracy of digital guide to achieve the accurate positioning of the implant fixture. The objective of this case report is to determine the accuracy of digital-guided implant surgical planning in multiple implant placement.

Case Description

A 77-year-old male patient with two missing lower left premolar teeth who came to Department of Prosthodontics with chief complaint of masticatory problem was selected for digital guided implant surgery treatment. After initial assessment of history taking, clinical examination, obtaining consent from the patient, laboratory blood tests, radiographic examination and intraoral scanning were performed before dental implant surgery. Preoperative CBCT and intraoral scanning were performed to fabricate digital surgical guide by using 3Shape digital implant studio software and Asiga 3D printer (Austria). After confirmation of drilling protocol and surgical report, implant surgery was carried out by using digital guided surgical kit of Dentium, Korea and 3D printed digital surgical guide. Guided surgical implant installation procedure under local anesthesia is as follows.

- Mucosa punch holes at 44 and 45
- Sequential widening of the space by using surgical drills
- 2 implants were installed for
  - 44 – 4 mm x 12 mm, Dentium, Superline
  - 45 – 3.8 mm x 10 mm, Dentium, Implantium

Surgical notes are

- Bone quality – D3
- Insertion Torque – 25 N/ TR
- Initial stability – +++

Then healing abutments were set as one stage protocol. After surgical procedure, panoramic radiograph (OPG) was taken to check the implant positions.

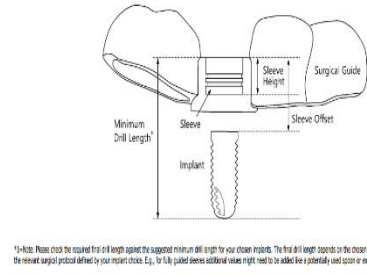
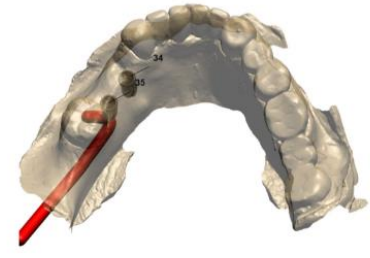


Figure 1. Drilling protocol for guided implant surgery



Implant information		
Implant position (FDI)	34	35
Manufacturer	Dentium	Dentium
Type	Dentium SuperLine D4.0 L10.0	Dentium SuperLine D4.0 L10.0
Order number	FXS4010	FXS4010
Length, mm	10	10
Diameter (Ø), mm	4	4
Color	Green	Green

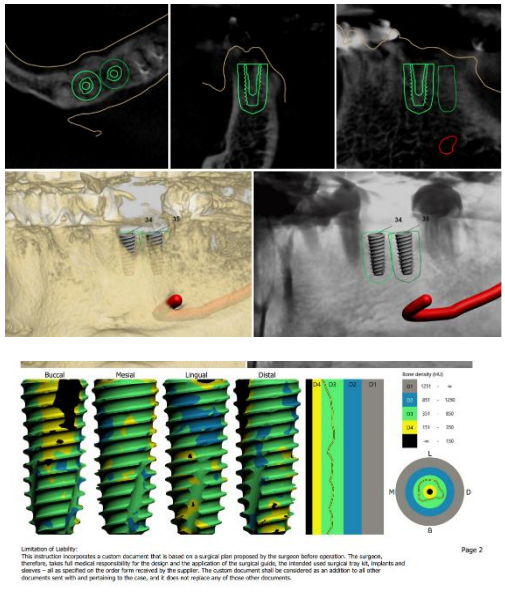


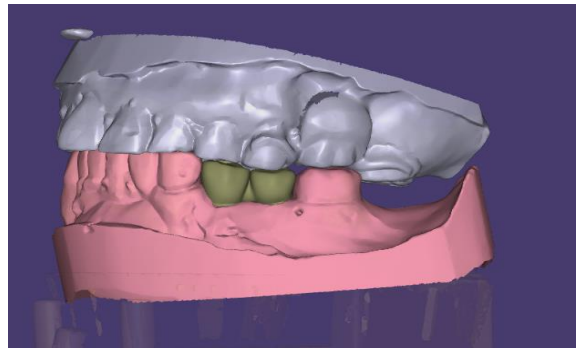
Figure 2. Surgical Report to confirm drilling protocol

Figure 3. Preoperative implant planning in CBCT

Figure 4. 3D printer and digital surgical guide

Figure 5. Guided implant surgical procedure

Figure 6. Postoperative OPG to check implant positions



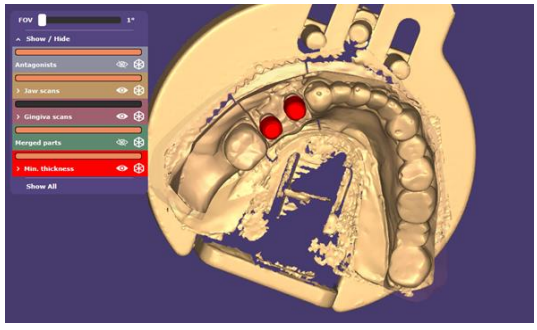


Figure 7. Designing implant prosthesis in CAD

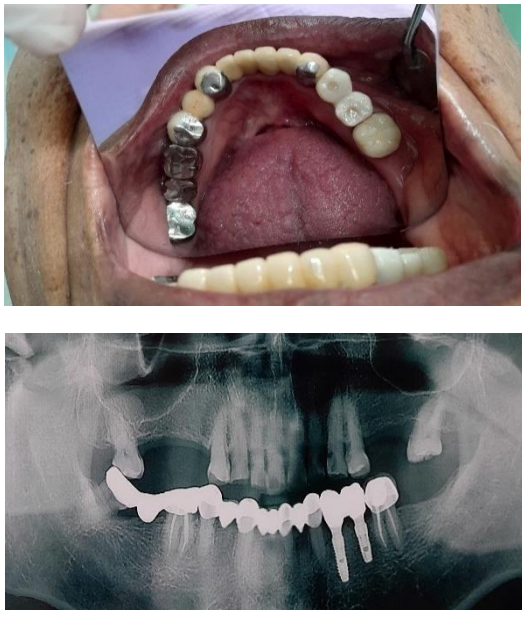


Figure 8. Implant prosthesis in position

Evaluation of implant position

The final positions of implants were checked by using postoperative orthopan-tomography (OPG) two dimensionally. It was found that two implants were in correct positions of interimplant and implant-natural teeth distances as planned. Although 3D analysis (CBCT) need to prove the implant angulations, the crestal and apical implant positions were satisfactory.

Evaluation on surgical procedure

Mucosal flap elevation for inspection of bony anatomy is not needed. Flapless surgery is safe, predictable, causing minimal discomfort during surgery, postoperative and periods of healing in combination with a reduced chairside time. Theoretically, the concept of computer guided implant placement may offer several clinical advantages in individual patient cases. This case report also confirms many benefits of guided implant surgery.

Evaluation of patients' satisfaction

Digital guided implant surgery provides the patients fearless and least dental anxiety. And also gives less postoperative discomfort, swelling, and pain to the patient.

Discussion

During the last decade, the technique for implant insertion has developed mostly due to achievements in radiographic 3D imaging technique and computer technology (Jung *et al.*, 2009; Schneider *et al.*, 2009; D'haese *et al.*, 2012). The techniques providing 3D digital information with respect to anatomical and prosthetic parameters using computed tomography (CBCT) and 3D implant planning software have developed rapidly during the past decade. Together with the advances in CAD/ CAM technique, digital data from the surgical plan can be transferred to the actual clinical settings using computer milled templates or stereolithographic surgical guides. A flapless surgical procedure may therefore be used applying these methods (Brodala, 2009; Hammerle *et al.*, 2009). In

addition, using the linkage of transferring the exact positioning of implants from the presurgical plan to the dental laboratory a prefabricated fixed prosthesis can be manufactured for immediate function of the inserted implants. This technique was primarily aimed at improving diagnostic, surgical and prosthetic precision. However, since the trend in implant dentistry today has focused mainly toward a rapid and simplified use, several commercially systems are at present available for clinical use where computer guided implant placement can be implemented in a complete sequence from the flapless surgical technique to immediate load with a prefabricated fixed prosthesis. The new concept is launched as being safe, predictable, causing minimal discomfort during periods of healing in combination with a reduced "chair time" for treatment. Theoretically, the concept of computer guided implant placement may offer several clinical advantages in individual patient cases (Hammerle *et al.,* 2009; Sanz & Naert 2009). For example, bone augmentation procedures may be avoided or reduced by optimizing implant positioning in accessible bone (Fortin *et al.,* 2009). By providing the clinician with realistic information of the bony anatomy as well as information of the prosthesis outline, an ideal implant placement can be virtually executed also in a prosthetically driven manner. As such, an optimal positioning may positively affect the final prosthesis function, speech and aesthetics. The flapless surgical technique is considered to cause less damage to the host and could as such be of advantage for clinically vulnerable patients, for example irradiated patients (Horowitz *et al.,* 2009) or when extensive bone grafting has been applied (Barter *et al.,* 2010). The minimally invasive surgical technique may therefore be of advantage in selected patient cases. Patients with fear and dental anxiety may also benefit from the flapless procedure since the surgical procedure is shortened and may give less postoperative discomfort, swelling, and pain (Nkenke *et al.,* 2007). By using the link of transferring the exact positioning of implants from the presurgical planning to the dental laboratory the CAD/ CAM technique has made it possible to manufacture a prefabricated fixed prosthesis which can be directly connected to the newly inserted fixtures. The advantage of such protocol is obvious in that the time of edentulism for the patient has been reduced giving immediate function and aesthetics (van Steenberghe *et al.,* 2005; Sanna *et al.,* 2007). There is an evidence that implant survival rate and effectiveness are similar for conventional and digital implant placement procedures (Colombo, 2017).

In the rapid development of computer technology, which already has influenced the traditional treatment concept of planning and implementing the different treatment steps of implant reconstruction, the clinical benefit of computer guided implant placement has to be consistently evaluated. In addition, to give a realistic understanding of a new technique, assessments must include cost effectiveness as well as patient-centered outcomes.

Clinical Recommendation

Nowadays, implant treatments are increasingly involved in general dental practice. Proper angulation and positioning of dental implants are essential to achieve acceptable prosthetic outcomes. Digital guided implant surgery could provide accurate implant position as planned and optimal patient comfort during, at the time and after surgery.

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Root Coverage with Subepithelial Connective Tissue Graft using Pouch and Tunnel Technique: A case report with 6 months follow-up

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Abstract **- Gingival recession is a common periodontal condition that can lead to root exposure, increased sensitivity, and aesthetic concerns. The pouch and tunnel connective tissue graft technique is an advanced surgical method designed to address this issue effectively by promoting gingival regeneration and root coverage. This case report provides an overview of the pouch and tunnel connective tissue graft technique, its procedural steps, benefits, and clinical outcomes in the treatment of gingival recession. The pouch and tunnel technique involve creating a subperiosteal tunnel beneath the gingival tissue without making vertical incisions. This preserves the blood supply and minimizes trauma to the surrounding tissues. A connective tissue graft is harvested from the donor site, typically the hard palate, and inserted into the prepared tunnel. The graft is positioned to cover the exposed root surface and secured in place. This case report have demonstrated that the pouch and tunnel connective tissue graft technique lead to significant root coverage, enhanced gingival thickness, and improved aesthetic outcomes. Patients typically experience minimal postoperative discomfort and a lower incidence of complications compared to traditional grafting methods. The technique's minimally invasive nature contributes to faster healing and better patient satisfaction. The pouch and tunnel connective tissue graft technique is a reliable and effective method for treating gingival recession. Its advantages include reduced surgical trauma, preservation of the vascular supply, and favorable clinical and aesthetic results. This technique is a valuable addition to the periodontal surgeon's repertoire for managing gingival recession and enhancing patient outcomes.**

Keywords: Gingival recession, connective tissue graft, pouch and tunnel technique, root coverage, periodontal surgery, dental aesthetics.

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Introduction

Gingival recession is an exposure of the root surface by an apical shift in the position of the gingiva which results in abrasion and ditching of the cementum apical to the cementoenamel junction (CEJ) (Newman *et al*., 2024).

Many etiologic factors such as periodontal diseases, incorrect occlusal

relationships, faulty tooth brushing methods, high frenal attachment, buccally erupted tooth, improper tooth movement by orthodontic treatment, improperly designed partial dentures, smoking habits, restorations, or chemicals can predispose the gingival recession. These can be localized or generalized (Miller, 1985).

As a result, esthetic impairment, hypersensitivity of the dentine, and caries or non-carious cervical lesions can be seen after the gingival recession and cementum exposure to the oral environment (Imammura *et al*., 2020).

A useful recession defect classification based on the height of the interproximal papillae and interdental bone adjacent to the defect area, and the relation of the gingival margin to the mucogingival junction is proposed by Miller in 1985. This classification is the mostly used and helpful in deciding the treatment options.

Class I: Marginal tissue recession does not extend to the mucogingival junction. There is no loss of bone or soft tissue in the interdental area. This type of recession can be narrow or wide.

Class II: Marginal tissue recession extends to or apical to the mucogingival junction. There is no loss of bone or soft tissue in the interdental area. This type of recession can be subclassified as wide and narrow.

Class III: Marginal tissue recession extends to or apical to the mucogingival junction. There is bone and soft tissue loss interdentally or malpositioning of the tooth facially.

Class IV: Marginal tissue recession extends to or apical to the mucogingival junction. There is severe bone and soft tissue loss interdentally or severe tooth malposition (Miller, 1985).

Furthermore, gingival recession presents significant therapeutic challenges for dentists, such as restoring the protective anatomy of mucogingival complex, the aesthetic restoration, regeneration of cementum, periodontal ligament and supporting alveolar bone and treatment of root sensitivity, prevention of root surface caries and prevention of periodontal disease progression in areas where proper hygiene can not be maintained (Shanker *et al*., 2023).

Moreover, it becomes more challenging in the treatment of multiple adjacent gingival recessions as the soft tissue management becomes difficult throughout the wound healing process by various factors such as the avascular surface's breadth, blood supply insufficiency, the arrangement of the teeth and the variations in the recession depth (Gaikwad *et al*., 2023).

Several techniques are used for gingival augmentation coronal to recession (i.e., root coverage):

1. Free gingival autograft
2. Free connective tissue autograft
3. Pedicle autografts
   - Laterally (horizontally) positioned pedicle flap
   - Coronally positioned flap; includes semilunar pedicle (Tarnow method)
4. Subepithelial connective tissue graft (Langer method)
5. Guided tissue regeneration
6. Pouch and tunnel technique (coronally advanced tunnel technique) (Newman *et al*., 2024).

Among others, the most effective and predictable treatment for radicular

coverage in gingival recession treatment is the connective tissue graft (Harris, 2004). Since early introduction of soft tissue grafting over 50 years ago, it has been increasingly used in clinical practice for augmentation of desired soft tissue thickness, adequate width of keratinized tissue reestablishment, mucogingival deformities correction, and esthetics improvement at teeth and dental implant sites (Zucchelli *et al*., 2019).

Studer *et al* in 1997 have demonstrated that keratinized gingiva at the palatal root of the first molar and the canine represent the best graft harvesting tissue because the connective tissue become thinner after these areas. Among the root coverage techniques, the pouch and tunnel technique eliminate the unnecessary incisions and protects the interdental papillae, ensuring the aesthetic outcome of the procedure (Shanker *et al*., 2023).

In 1994, Allen described the “tunnel” technique and it includes preparation of a supraperiosteal mucosal flap with intrasulcular incisions. This technique allows the mobilization of the cervical gingiva and therefore, the creation of a "pouch". By undermining the interdental papillae, a mucogingival tunnel can be elaborated between all adjacent pouches. Subepithelial connective tissue graft is then placed through the tunnel, partially exposed over recessions and sutured in this position (Shanker *et al*., 2023).

This case report presents the clinical outcome of a gingival recession case that was treated with sub-epithelial connective tissue grafting by pouch and tunnel technique. This case has a total follow up of 6 months.

Case Report

A 22-year-old male, non-smoker, presenting gingival recession at lower right anterior tooth, came to Department of Periodontology at University of Dental Medicine, Yangon with a chief concern of his gum recession at esthetic region. He mentioned that he usually brushes his teeth horizontally. He did not present any medical contraindication for periodontal surgery.

Clinical examination revealed that class II gingival recession at lower right canine. Probing Depth (PD) = 2mm, Clinical Attachment Level (CAL) = 6mm, BoP score was 2, Total WKG (Width of Keratinized Gingiva) = 0 and thinned gingival biotype. The treatment plan was aimed to increase the total width of keratinized gingiva and thicken the biotype of the gingiva

Figure 1. Class II gingival recession at lower right canine

After obtaining the written informed consent, patient was

undergone non-surgical periodontal therapy. Patient was advised to perform tooth brushing with Bass method and followed the oral hygiene instructions. Two weeks after the non-surgical therapy, FMBS (Full Mouth Bleeding Score) and FMPS (Full Mouth Plaque Score) were assessed to check whether the patient was suitable for periodontal surgery.

As FMBS and FMPS scores were less than 25%, patient was planned to proceed the surgery. Based on the clinical examination, surgery was done with the pouch and tunnel technique using the subepithelial connective tissue graft. Before the surgery, patient was instructed to rinse with 0.12% Chlorhexidine gluconate solution for 30 seconds. The surgical procedure was carried out under Local Anesthesia (2% Lidocaine with 1:80,000 adrenaline). After local anesthesia was administered, scaling and root planing were performed on the root without using any biomodification agent.

#15c blade were used to made the initial surgical incisions. Microsurgical blade (No-69) and tunneling instruments were used to create the recipient pouches and tunnels. On the buccal aspect, an intrasulcular incision was made around the teeth. The incision extended to one adjacent tooth medially and distally. The sharp edge was directed toward the bone to dissect the connective tissue beyond the mucogingival line and detached the buccal flap from the alveolar bone. The papilla was kept intact. Thereafter, an envelope - pouch and tunnel was created and extended apically beyond the mucogingival line by blunt dissection for the subepithelial connective tissue graft insertion through the intrasulcular incision. The size of the pouch including the denuded root surface was measured to ensure to retrieve the equivalent size from the palate. The desired size of subepithelial connective tissue was harvested from the hard palate between canine and first molar region with trap door technique and grafted into the recipient pouch and tunnel. A vicryl 5/0 reversed cutting, 3/8 circle suture were used. Each end of the connective tissue was gently pushed through the prepared pouch and tunnel and anchored to the inner aspect of the buccal flap in the interdental papilla area. A vertical mattress suture was used to hold the connective tissue in position beneath the gingiva.

The connective tissue graft was completely submerged beneath the buccal pouch and papillae. The buccal gingiva with the underlying connective tissue graft and papillae was coronally positioned using a vertical mattress suture anchored at the labial surface of the adjacent tooth. The suture was splinted to the tooth surface with light-cured resin to prevent sliding apically. Other holding sutures were also placed through donor tissue to overlying gingival tissue and donor tissue to the underlying periosteum. The palatal donor site was also sutured to cover exposed wound and promote healing.

Patient was informed to take amoxicillin 500 mg three times per day for 5 days. The patient was instructed to rinse daily with chlorhexidine gluconate 0.12%. Patient was instructed to avoid touching the suture, biting the objects and stopped any oral hygiene procedure at the surgical site, but not other remaining regions. After

2 weeks, sutures were removed and supragingival debridement was done. Patient was advised to resume all the oral hygiene procedures. Then, clinical periodontal parameters were recorded at 6 weeks and 24 weeks respectively.

Results

In post-operative 6 weeks, the results were favorable with reduction of clinical attachment level, reduction of recession depth, increased total width of attached gingiva, thickened attached gingiva with no bleeding on probing. The clinical attachment level is reduced to 4 mm at 6 weeks and 3 mm at 24 weeks. Furthermore, total width of attached gingiva become 3 mm at post-operative 24 weeks.

Figure 2. Post-operative 2 weeks

Figure 3. Post-operative 12 weeks

Discussion

The pouch and tunnel connective tissue graft technique is a minimally invasive surgical procedure involving creating a small pouch or tunnel in the gingival tissue and placing a connective tissue graft within it to cover exposed tooth roots. It is the procedure which aimed at enhancing the aesthetics, effective root coverage, thicken gingival tissues and favorable functional outcomes.

In this case, clinical attachment level was 6 mm and positive bleeding on probing despite periodontal probing depth was 2 mm before the surgery. In order to achieve the significant root coverage and thickening of the attached gingiva, the pouch and tunnel was the most preferable method to choose. In addition, several researches and clinical studies have demonstrated the promising results of the effectiveness and benefits of the pouch and tunnel technique. Moreover, this technique is also associated with high patient satisfaction due to its minimally invasive nature and reduced postoperative discomfort. As the results of this case, the clinical attachment level gain was 3 mm and total width of attached gingiva changed from 0 to 3 mm at 6 months follow-up. Following the outcome, the pouch and tunnel connective tissue graft technique allows the complete coverage of the root with optimal vascularization, even with thin periodontal phenotypes.

Conclusion

The pouch and tunnel connective tissue graft technique offers numerous benefits, including minimal invasiveness, excellent aesthetic results, high success rates, long-term stability and improved patient post-operative comfort. These advantages make it a preferred choice for treating gingival recession.

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Diode Laser Pulpotomy in Deciduous Molar: Case Report

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***Abstract* - Diode laser has emerged as a promising technique in paediatric dentistry for managing pulpotomy in primary teeth. This minimally invasive procedure involves the precise removal of the coronal pulp tissue using a diode laser, aiming to preserve the vitality of the remaining radicular pulp tissue. In this case report, a 6-year-old boy with reversible pulpitis at the left deciduous mandibular second molar was treated with diode laser pulpotomy and a full coronal coverage using a stainless-steel crown. Clinical and radiographic examinations were performed at three and six months. At the end of 6 months, the tooth was free of any clinical and radiographic signs of inflammation and infection.**

Keywords: Laser pulpotomy, diode laser, deciduous molar

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Introduction

Dental caries is the most Dental caries is the most frequent non-communicable disease that affects 60-90% of children worldwide (Petersen *et al.,* 2005). Untreated dental caries may result in bacterial invasion into the coronal pulp and subsequent inflammation and infection of the pulp (Gonzalez-Lara *et al.*,2016). Therefore, effective pulp therapy in the primary dentition is needed not only to stabilize the affected primary tooth but also to create a favorable environment for normal exfoliation of the primary tooth without harm to the developing enamel or interference with the normal eruption of its permanent successor (Cameron & Widmer, 2013).

Pulpotomy is the most widely used endodontic technique in primary dentition. It is defined as the complete removal of the coronal portion of the dental pulp, followed by the placement of a suitable dressing or medicament that will promote healing and preserve the vitality of the tooth (Tandon, 2018).

Many pharmaco-therapeutic techniques have been used when performing pulpotomies in primary teeth. Over the last 70 years, Buckley's formocresol (FC) solution has remained the popular medicament due to its high clinical and radiographic success rates. The formaldehyde component of FC has been proven to be highly effective as an antibacterial agent. However, in 2004, the International Agency for Research on Cancer (IARC) classified formaldehyde as a carcinogen that could potentially cause leukaemia and nasopharyngeal carcinoma (Bagchi *et al.,* 2021). For these reasons, a variety

of medicaments such as glutaraldehyde, ferric sulfate, calcium hydroxide, bone morphogenic protein, sodium hypochloride, mineral trioxide aggregate, and biodentine have been proposed to replace FC (Jha *et al.*, 2021). The use of herbal medicatments such as Aloe Vera, Allium Sativum, Ankaferd Blood Stopper, Propolis, and Elaegnus Angustifolia is on the raise to reduce potential side effects (Divya & Sujatha, 2018). Electrosurgery and laser are the non-pharmacological treatment modalities used for the pulpotomy procedure (Gupta *et al.*, 2015).

Due to technological advancements, the use of lasers has become popular in dentistry. Shoji *et al.*, (1985) first applied carbon dioxide (CO_2) laser pulpotomy in dogs and reported no detectable damage to the radicular pulp tissue. After that, several studies have conducted various types of lasers, including CO_2 laser, neodymium-doped yttrium aluminum laser (Nd: YAG), erbium family of laser, and diode laser, as an alternative to conventional pulpotomy procedures (Durmus & Tanboga, 2014).

Diode laser is the most frequently used laser in paediatric dentistry due to its reliability, versatility, convenience, and simple setting-up (Olivi *et al.*, 2011). It uses a solid gallium aluminum arsenide (GaAlA) semiconductor as an active medium operating in the near-infrared spectral region between 808 and 980 nm that is capable of producing well-localized ablation of soft tissue through conversion of the laser energy to heat. The diode laser wavelength is highly absorbed by pigmented tissues containing hemoglobin, melanin, and collagen chromospheres and shows little absorption by hard dental tissue (Maturo *et al.*, 2013). Since it is a contact laser, pulpotomy is performed by placing a laser tip in contact with the coronal pulp tissue affected and leaving the remaining radicular pulp tissue unaffected (Saltzman *et al.*, 2005).

Although the use of lasers in dentistry is gaining popularity worldwide due to its safety and effectiveness, there are currently no research articles on this topic in Myanmar. However, as more clinics adopt laser dentistry, there is a need for scientific research to provide better quality care to patients. Hence, this case report aims to present the clinical and radiographic findings of vital pulpotomy using diode laser conducted on a deciduous mandibular second molar.

Case report

A 6-year-old healthy boy was referred to the Department of Paediatric Dentistry, University of Dental Medicine (Yangon) for proper management of his carious tooth. He reported with the chief complaint of toothache on the lower left posterior teeth while eating, but no pain at night. There were no history of swelling and medications. The child was well cooperative with the dentist and dental environment. His parents had a positive parental attitude and they insisted on saving their child's tooth.

On clinical examination, there was a large carious lesion at the left deciduous mandibular second molar (Figure 1). There was no tenderness on percussion, no associated sinus opening adjacent to the involved teeth,

and no pathologic mobility. A pre-operative intra-oral periapical radiograph confirmed a deep occlusal carious lesion involving the pulp without furcation or periapical radiolucency, and root length was confined to more than two-thirds of the root (Figure 2).

Considering dental history, clinical and radiographic examinations revealed that the initial diagnosis was reversible pulpitis with normal periodontal status. Possible treatment option for this deciduous molar was vital pulpotomy.

After administration of local anesthesia by inferior alveolar nerve block injection using 2% lidocaine with 1:80,000 epinephrine and isolation of the tooth with a rubber dam. Dental caries was excavated to eliminate infected dentine and determined the pulp exposure site. Following caries removal and exposure of the pulp, a standard access opening was prepared by removing the entire roof of the pulp chamber using a large round bur with a high-speed hand-piece under water spray to facilitate visualization of the chamber. Then coronal pulpal tissue was removed using a sterile sharp spoon excavator and the pulp chamber was irrigated with normal saline (Figure 4).

Laser pulpotomy was performed at a laser clinic under the guidance of laser committee members of the University of Dental Medicine (Yangon). For laser safety, the laser room was secured by limiting access, and a “laser in use” sign was posed. The operator, patient, and all the team members used wavelength-specific protective eyewear within the treatment area. High-efficiency particulate filtration masks (particle filtration efficiency of 99.75% at 0.1 µm) were worn by the operator and all the team members. A highly efficient suction was used during laser application to protect laser plumes which contain organic and inorganic matter including viruses, toxic gases, and chemicals developed from laser-tissue interaction.

Firstly, the fiber tip was initiated on carbon paper. After that, the remaining coronal pulp tissue was exposed to laser energy using a Dentek LD-15 diode laser of 810 nm wavelength set at 2 Watts of power in continuous wave (Figure 3). The laser energy was delivered through a 0.5mm diameter optical fiber with the penetration depth of 400 µm was in contact with pulp tissue every 10-15 seconds, repeated until a charred layer appeared (Figure 5). Gentle irrigation with normal saline after laser irradiation. Subsequently, the pulp stump was observed from brownish to black discoloration of fixed radicular pulpal tissue on the orifices (Figure 6).

Polymer-reinforced zinc oxide eugenol cement was placed with light pressure in the pulp chamber as an intermediate restorative material (Figure 7). Then, pulpotomized tooth was prepared for tooth reduction to accommodate the placement of a stainless steel crown for the coronal restoration, which was then cemented using glass ionomer luting cement (Figure 8). This diode laser pulpotomy procedure was performed in one session.

Clinical and radiographic evaluations of the success of diode laser pulpotomy were based on the following criteria: absence of pain,

tenderness to percussion, soft tissue swelling, abscess, sinus tract, and pathologic mobility; lack of periapical or furcation radiolucency, internal or external root resorption, no widening of periodontal ligament (PDL) space.

The patient was regularly recalled at 3-month and 6-month intervals. We found clinical success at 3-month and 6-month follow up visits. On periapical radiographs, there was no radiolucency at furcation and apical region with normal PDL space (Figures 9 and 10) at each follow-up appointment. The tooth was fully functional and the patient was asymptomatic.

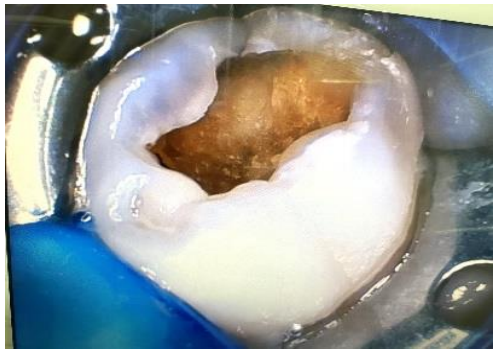

Figure 1. Pre-operative clinical view

Figure 2. Pre-operative intraoral periapical radiograph

Figure 3. DENTEK LD-15 diode laser

Figure 4. Removal of coronal portion of pulp chamber

Figure 5. Diode laser irradiation to remaining coronal pulp tissue

Figure 6. After laser irradiation, black discoloration of fixed radicular pulpal tissue on the orifices

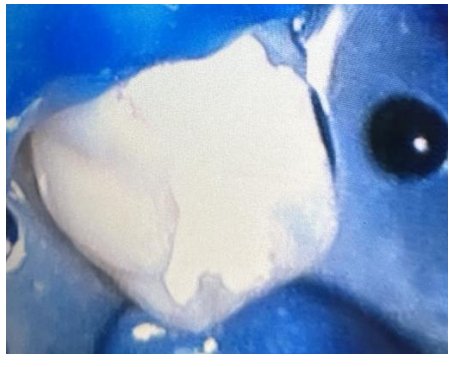

Figure 7. Placement of intermediate restorative material

Figure 8. Coronal restoration with stainless steel crown

Figure 9. Three months after laser pulpotomy

Figure 10. Six months after laser pulpotomy

Discussion

Pulp therapy has many controversies than any other treatment in pediatric dentistry especially pulpotomy. Many techniques have been used for pulpotomy procedures in primary dentition. With the development of technologies and considering some of the advantages, such as bleeding control, sterilization, and stimulation of pulp cell healing, the use of lasers with different wavelengths is advocated as a possible alternative treatment option (Tandon, 2018).

In a study by Yudav *et al.*, diode laser pulpotomy was performed with 810 nm set at 3 W of power in continuous wave and the laser energy was delivered through a 400µm diameter optical fiber in a non-contact mode to pulp tissue for 2-3 seconds has shown 100% success at 9-month interval (Yadav *et al.*, 2014). Another study used a diode laser set at a wavelength of 810 nm, a power of 1.5 W for 10 sec, air-cooling mode and fiber tip was kept 1–2 mm from touching the pulp tissue has also shown 100% success at 12-month interval (Durmus & Tanboga, 2014). In Gupta *et al.*, study, pulp was ablated to the level of the canal orifice using diode laser set at 980 nm wavelength, 3 W of power, continuous mode and the laser energy delivered through 400µm fiber in contact with pulp tissue for 2 minutes and 31 seconds has proved 100% success after 12-month follow-up (Gupta *et al.*, 2015).

As observed from the literature, the diode laser pulpotomy was performed in this case with 810 nm wavelength set at a power of 2 W and continuous wave mode. Laser energy was delivered through a fiber of 400 µm. When the pulp is irradiated with laser creates a superficial zone of coagulation necrosis that remains compatible with the underlying tissue and isolates the pulp from harmful effect of the sub-base (Sivadas *et al.*, 2017).

Thermal injury to the pulp depends on the length of laser exposure rather than the output power of the device (Mareddy *et al.*, 2010). In this case, the laser beam penetrates the pulp chamber only for 10-15 seconds of exposure time. Removing the remaining coronal pulp by using the laser results the pulp stumps in a hemostasis which made the restorative material be rapidly placed without any hematic contamination.

The long-term maintenance of pulp vitality following pulpotomy depends on the quality and seal of final restoration (Tan *et al.*, 2020). The loss of coronal restoration can lead to pulpotomy failure so we used a stainless-steel crown as final restoration for pulpotomized molar.

Regarding postoperative pain scores at 48 hours, the patient did not experience postoperative pain in this case. The reduction in postoperative pain may be attributed to the anti-inflammatory effect of diode laser, which decreases chemical mediators like prostaglandins, substance P, and others (Ginani *et al.*, 2015).

The success rate of pulpotomy has been measured conventionally as the percentage of teeth with absence of clinical or radiographic findings of disease (Cameron & Widmer, 2013). Similarly, in this case, the success rate of the laser pulpotomy treatment was defined as the absence of any clinical

or radiographic pathology at the follow-up appointments. We found out, vital pulpotomy using diode laser was 100% clinical and radiographic success at three months and six months intervals.

The limitation of this case was a relatively short follow-up period, therefore the larger sample sizes with the long-term randomized control trials are needed for further studies to be conducted to reach definitive outcomes.

Conclusion

In accordance with the favorable results of our case, the diode laser was shown to be a safe, nonchemical, effective tool for treating vital pulpotomy in deciduous molar. The tooth will be followed until exfoliation and eruption of its permanent successor for long-term prognosis. If the success rate remains high, then diode laser pulpotomy can be considered a paradigm shift in pediatric dentistry by working as an alternative to conventional pulpotomy technique for providing a modern advanced, and comfortable treatment to the children.

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